1987

Nuclear winter and nuclear policy: implications for U.S. and Soviet deterrence strategies

Griffin, Gail Alane.

Monterey, California: U.S. Naval Postgraduate School

NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

NUCLEAR WINTER AND NUCLEAR POLICY:
IMPLICATIONS FOR U.S. AND SOVIET
DETERRENCE STRATEGIES

by

Gail Alane Griffin

September 1987

Thesis Advisor: K.M. Kartchner

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b RESTRICTIVE MARKINGS
2a SECURITY CLASSIFICATION AUTHORITY	3 DISTRIBUTION / AVAILABILITY OF REPORT Approved for public release; distribution is unlimited
2b DECLASSIFICATION / DOWNGRADING SCHEDULE	
4 PERFORMING ORGANIZATION REPORT NUMBER(S)	5 MONITORING ORGANIZATION REPORT NUMBER(S)
6a NAME OF PERFORMING ORGANIZATION Naval Postgraduate School 6b OFFICE SYMBOL (If applicable) Code 56	7a NAME OF MONITORING ORGANIZATION Naval Postgraduate School
6c ADDRESS (City, State, and ZIP Code) Monterey, California 93943-5000	7b ADDRESS (City, State, and ZIP Code) Monterey, California 93943-5000
8a NAME OF FUNDING / SPONSORING ORGANIZATION 8b OFFICE SYMBOL (If applicable)	9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c ADDRESS (City, State, and ZIP Code)	10 SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO / PROJECT NO / TASK NO / WORK UNIT ACCESSION NO

11 TITLE (Include Security Classification)
NUCLEAR WINTER AND NUCLEAR POLICY: IMPLICATIONS FOR U.S. AND SOVIET DETERRENCE STRATEGIES

12 PERSONAL AUTHOR(S)
Griffin, Gail A.

13a TYPE OF REPORT	13b TIME COVERED FROM ____ TO ____	14 DATE OF REPORT (Year Month Day)	15 PAGE COUNT
Master's Thesis		1987, September	126

16 SUPPLEMENTARY NOTATION The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

17 COSATI CODES		
FIELD	GROUP	SUB-GROUP

18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
Nuclear Winter; U.S. Nuclear Policy; Soviet Nuclear Policy

19 ABSTRACT (Continue on reverse if necessary and identify by block number)

Nuclear weapons were rapidly incorporated into the policies for maintaining the national security objectives of both the Soviet Union and the United States--in spite of poorly understood nuclear weapons effects.

The nuclear winter hypothesis, the basis of which was first proposed in 1982, directed scientific research into the consequences of massive amounts of dust and smoke, from nuclear detonations, on the earth's climate and subsequently on the ecology of the earth. This thesis presents the evolution of the nuclear winter hypothesis in order to elucidate its unique aspects for global devastation and the consensus of plausibility which the hypothesis holds in the scientific community.

20 DISTRIBUTION / AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS	21 ABSTRACT SECURITY CLASSIFICATION Unclassified
22a NAME OF RESPONSIBLE INDIVIDUAL Prof. Kerry M. Kartchner	22b TELEPHONE (Include Area Code) (408) 646-3483 22c OFFICE SYMBOL Code 56Kn

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted
All other editions are obsolete

SECURITY CLASSIFICATION OF THIS PAGE
UNCLASSIFIED

#19 - ABSTRACT - (CONTINUED)

The hypothesis has aroused a flurry of debate on its implications for nuclear policy. With the historical aspects of the nuclear era as a backdrop, the question of incorporating new scientific information on the consequences of nuclear war into policy is discussed.

The observed responses of the U.S. and Soviet Union and the implications for future actions in response to the nuclear winter hypothesis are examined--leading to the conclusion that the hypothesis will have little or no impact on U.S. and Soviet nuclear policy.

Approved for public release; distribution is unlimited

Nuclear Winter and Nuclear Policy: Implications for U.S. and Soviet Deterrence Strategies

by

Gail Alane Griffin
Lieutenant, United States Navy
A.B., University of Illinois, 1972

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN NATIONAL SECURITY AFFAIRS

from the

NAVAL POSTGRADUATE SCHOOL
September 1987

ABSTRACT

Nuclear weapons were rapidly incorporated into the policies for maintaining the national security objectives of both the Soviet Union and the United States--in spite of poorly understood nuclear weapons effects.

The nuclear winter hypothesis, the basis of which was first proposed in 1982, directed scientific research into the consequences of massive amounts of dust and smoke, from nuclear detonations, on the earth's climate and subsequently on the ecology of the earth. This thesis presents the evolution of the nuclear winter hypothesis in order to elucidate its unique aspects for global devastation and the consensus of plausibility which the hypothesis holds in the scientific community.

The hypothesis has aroused a flurry of debate on its implications for nuclear policy. With the historical aspects of the nuclear era as a backdrop, the question of incorporating new scientific information on the consequences of nuclear war into policy is discussed.

The observed responses of the U.S. and Soviet Union and the implications for future actions in response to the nuclear winter hypothesis are examined--leading to the conclusion that the hypothesis will have little or no impact on U.S. and Soviet nuclear policy.

TABLE OF CONTENTS

I. INTRODUCTION: THE NUCLEAR BACKDROP-- U.S. AND SOVIET VIEWS

'Nuclear peace' has been maintained for over 40 years--through cold wars, regional conflicts, and acts of terrorism. The world's nuclear arsenal of over 50,000 warheads has shaped nations' interactions even through its non-use. The past 40 years tend to suggest a high level of stability in our nuclear relationships--but it is a stability that is constantly challenged. Policy makers must ask the questions of how best to maintain the stability, what actions should be taken should this stability fail, and what the consequences of its failure might be.

Technology permitted the development of nuclear weapons before the technology existed to analyze the effects of their use. Policy makers must consider these effects if they are to address the consequences of stability failing in the formulation of policy. As stated by Dr. Arthur Katz in Life After Nuclear War, "A realistic understanding of the effects of nuclear war is needed so that the implicit assumptions upon which nuclear policy alternatives are based may be understood." [Ref. 1:p. 4] Strategic plans have clearly responded to advances in weapon technologies. MIRVing capabilities and increased targeting accuracy have provided nuclear response options to the early U.S. policy of massive retaliation.

Advancements in technology have also stimulated the scientific communities' investigation beyond the immediate effects of nuclear weapons and their military applications, into the long-term effects and ecological impact of nuclear weapons' use. The difficulties of decision making in response to this area of information reflect not only the conflicting notions of how best to achieve national security goals, but also the uncertainties of our present fragmentary understanding of long-term effects. The nuclear winter hypothesis[1], which deals with the atmospheric and climatic consequences of a nuclear exchange, is the most recent area of investigation into a previously unappreciated realm of potential consequences. If strategic decision makers are to respond and incorporate new information on long term effects into policy, the responses must be made within the framework of our existing nuclear strategy and policies for national security.

A. U.S. NUCLEAR POLICY

This section will provide the nuclear backdrop to the United States' quest for national security. The concerns and forces that influenced the evolution of U.S. nuclear

---

[1]The term "nuclear winter" will be used throughout this thesis for the sake of simplicity. It is noted, however, that many scientific analyses avoid the term for reasons similar to the one given in the SCOPE report, ". . . it does not, in a strict scientific sense, properly portray the range, complexity, and dependencies of the potential global scale environmental consequences of a nuclear war." [Ref. 2:p. xi]

policy will be presented in order to later examine the nuclear policy issues raised by the new scientific evidence surrounding the nuclear winter hypothesis.

Soviet reaction to the nuclear winter hypothesis is a major factor for consideration when discussing possible U.S. responses in nuclear policy which impact our deterrence posture. U.S. nuclear policies will be contrasted with Soviet views, since it is the behavior of the Soviets with which the United States is most concerned. Casper Weinberger, in his Annual Report to the Congress Fiscal Year 1988, states,

> Of the threats to our national security that our defense programs are designed to meet, that posed by the Soviet Union is by far the most serious and the most immediate. . . . the largest, and most expensive, part of our defense effort is driven by the power and policy of the Soviet Union. [Ref. 3:p. 23]

The basic defense strategy of the United States is the deterrence of aggression. Since the end of World War II, this strategy has relied on nuclear weapons to dissuade

> our adversaries by the threat of retaliation from ever using nuclear weapons against the United States, our allies, or our friends. At the same time, . . . our defense policy has continued to rely on U.S. nuclear weapons to help deter conventional attacks, as well. . . . [Ref. 3:p. 51]

Over the years, the official statements pronounced by each Administration as our nation's nuclear policy, i.e., the declaratory policy, have undergone many modifications to the basic strategy of nuclear deterrence and have exhibited conflicting approaches of how best to achieve deterrence.

Aaron Friedberg describes, in a simplified form, the two major schools of thought on deterrence philosophy which have affected the modifications to U.S. declaratory policy and which are contrasted in their influence on the military's wartime employment plans or operational policy. The nuclear winter hypothesis has potential for altering the impact of each school of thought, particularly in their impact on declaratory policy. The 'assured destructionist' school emphasizes the importance of the countervalue deterrent, the dangers of regarding nuclear forces as ordinary weapons of war, the risks of threatening the enemy's nuclear capabilities, the value of stability and the necessity for indices of 'sufficiency.' [Ref. 4:p. 39] Bernard Brodie's The Absolute Weapon published in 1946 clearly expressed the belief that there could be no military or politically meaningful form of victory in a nuclear war. The basic premise underlying the doctrine of mutual deterrence states that modern strategy should be geared to prevent wars (not to win them), with an emphasis on sufficiency in strategic weapons rather than superiority. This school of thought has had a particularly powerful impact on the United States' approach to defense, wherein meaningful defenses are frequently characterized as technically impossible, psychologically counterproductive, or destabilizing. [Ref. 5:p. 25] For example, the current debate over the Strategic Defense Initiative (SDI) contains elements of this thinking

in the arguments against SDI. Many of these arguments are similar to those made in opposition to implementation of Anti-Ballistic Missile (ABM) systems in the late 1960s. These analogous arguments include: 1) technical infeasibility; 2) destabilization (may prompt a pre-emptive attack or fuel an action-reaction arms race); and, 3) unacceptable expense for implementation.

The other school of thought displays a more traditional military approach to war. It focuses on war outcomes, on the importance of preparing to achieve objectives of war (should deterrence fail), and on the necessity for defeating the enemy by denying him his objectives and destroying his willingness and ability to wage war. The operational war plans of the United States have reportedly been guided by this school of thought with consistency. [Ref. 4:pp. 37-71] Since 1945, U.S. declaratory policy has at times been dominated by one or the other of these approaches. Their coexistence has created situations characterized by a mismatch of declaratory and operational policy, and of a mismatch of declaratory policy and capabilities.

A brief summary of U.S. nuclear policy is provided in order to characterize the dominant concerns and forces. Following World War II, the reliance on nuclear weapons was greatly influenced by the economics of defense. Nuclear weapons are more cost effective than larger conventional

forces. Cost continues to be the primary factor holding back the build-up of NATO's conventional forces.

The U.S. nuclear arsenal was extremely small during the first five years of the nuclear era, and there were no Soviet nuclear weapons until 1949. As both Soviet and U.S. arsenals began to expand, more targeting alternatives were added to the war plans. The policy of Massive Retaliation, developed early in the Eisenhower administration, promoted Soviet containment via superior nuclear military forces sustained by a strong national economy. The U.S. was prepared to mount a massive strike on the Soviet Union with impunity.

In 1960 a Joint Strategic Target Planning Staff (JSTPS) was formed to facilitate inter-service cooperation, to draw up a National Strategic Target List (NSTL) and to prepare a Single Integrated Operational Plan (SIOP). An optimum mix of high priority military, industrial and government control targets was designated. [Ref. 4:p. 42] Since this time, the operational plans which allocate a significant portion of U.S. strategic forces to military targets have been remarkably consistent. Declaratory policy, however, went through significant changes in the 1960s.

As the size and destructive capabilities of Soviet forces continued to grow and the U.S. was perceived as being more vulnerable, a reevaluation of U.S. declaratory policy took place. Slowly the emphasis shifted from deterrence

through strategic superiority and from threats of first use to an emphasis on deterrence and stability through a secure second-strike capability and flexible options of retaliation.

In the mid 1960s Secretary of Defense McNamara proposed the concept of Assured Destruction and Damage Limitation. Assured Destruction, which was similar to massive retaliation, was defined as the ability to inflict an unacceptable degree of damage on an aggressor even after absorbing a surprise first attack. The "unacceptable degree" of damage was arrived at through a systems analysis approach which determined a finite amount of force required to inflict the damage--i.e., 400 equivalent megatonnage (EMT). Thus, this approach allows for budgetary limits to be set on strategic procurements on the basis of cost-effectiveness criteria.

The concept of Damage Limitation incorporated a warfighting posture involving counterforce targeting requiring offensive and defense capabilities. Damage Limitation advocacy was short-lived, as the emphasis passed to Assured Destruction alone. In part, Damage Limitation fell from favor due to budgetary considerations--it did not offer the convenient finite aspect of weapons procurement. It was also criticized as increasing defense expenditures without any real gain in security (stressing the approach

that there is no effective defense from nuclear war), and as promoting a destabilizing strategy of first strike.

The adoption of Assured Destruction as the declaratory policy by 1968 did not affect the operational targeting plans. It did, however, have a significant impact on U.S. strategic force capabilities which would continue to raise concern over the inability to carry out an operational plan dependent on forces based on a different declaratory policy. The Assured Destruction concept places almost total emphasis on deterrence vice nuclear warfighting.

President Nixon's sufficiency doctrine was based on a belief that previous U.S. superiority was no longer attainable or meaningful. Sufficiency was equated with an adequate second-strike force. As the Soviets' force capabilities increased and parity was acknowledged, Assured Destruction became termed Mutual Assured Destruction (MAD) by the West. Arms control took on increasing importance in the West as a means of achieving strategic stability. Although Mutual Assured Destruction was never an official policy of the U.S., it was the basis for the negotiating approach of the U.S. to the SALT I and ABM talks. The Western objectives in SALT were to place limits on strategic offensive arms but to still permit each side to maintain a nuclear arsenal capable of inflicting unacceptable damage. The ABM Treaty limited the ability of each side to reduce the expected level of damage resulting from the adversary's

nuclear retaliatory response. This approach was supposed to create strategic stability where neither side has an incentive to strike first. "The MAD and its SALT I companion seemed to mark the end of U.S. postwar attempts to maintain superiority in strategic weapons." [Ref. 6:p. 155]

A major flaw in the MAD concept was its unilateral acceptance by the West. In spite of hopeful attempts at "educating" the Soviets in Western deterrence theory, it eventually became apparent that their strategy and objectives were in fact different than that of the U.S. The Soviets have continued with their steady investment in counterforce capable offensive forces, and in air, civil and ballistic missile defenses undermining the credibility of an Assured Destruction policy. [Ref. 7:p. 23]

The early 1970s saw a revived interest in Damage Limitation and counterforce targeting (with a survivable assured destruction capability held in reserve). This change was brought about by the influences of improved technology (limited nuclear options were now more feasible), the changing nuclear balance, a greater appreciation for Soviet views on nuclear war, and appreciation for deterrent credibility as <u>perceived</u> by the adversary. The new strategic doctrine proposed by Secretary of Defense Schlesinger and promulgated in 1974 as National Security Decision Memorandum (NSDM) 242 rejected the MAD philosophy. The new doctrine retained the theme of maintaining an

adequate second-strike force but added an emphasis on planning to use nuclear weapons much more selectively than had been planned in the past. Limited nuclear options (LNOs) made possible by advanced technology, provided flexible hard and soft targeting options which would minimize collateral damage. This new doctrine also made possible consideration of a protracted nuclear war--selective use with minimized damage indicated that a nuclear exchange could occur over a long period of time. These characteristics of NSDM-242 have continued to be a part of U.S. declaratory policy since 1974.

President Carter endorsed the Countervailing Strategy in 1980. The Countervailing Strategy of Presidential Directive (PD) 59 stressed the ability to retaliate at any level of conflict so as to deny the enemy's objectives. The Reagan Administration's Force Modernization Program stresses the implementation of this strategy through revitalization of strategic offensive and defensive forces.

The more traditional military approach to war has reappeared in the present U.S. declaratory policy and has shaped the operational plans since the 1960s. In the aspect of counterforce targeting as a warfighting strategy, the U.S. declaratory nuclear policy has become more similar to that of the Soviet Union. However, the present U.S. declaratory policy continues to be a matter of intense debate. The nuclear winter hypothesis may intensify this

debate, by challenging the present policy of nuclear weapons' use. The notions of assured destruction--that counterforce targeting and defensive systems are inherently dangerous, and that nuclear weapons cannot have military and political utility--are deeply entrenched in the American public's view of nuclear war.

B. THE SOVIET VIEW OF NUCLEAR WAR

The changes imparted to the U.S. declaratory policy in the 1970s were due, in part, to an appreciation and recognition for Soviet doctrine. If the U.S. hopes to correctly anticipate (and possibly counter) the Soviet Union's response to the nuclear winter hypothesis, this appreciation must continue. Although the question of Soviet motives and objectives has many answers dependent on the analyst's particular paradigm, there are, as Casper Weinberger notes in his Report to the Congress, facts of Soviet policy and military capability to which the U.S. must respond. The Soviet Union has displayed consistent efforts and success in building an enormous military capability. [Ref. 3:p. 23]

An investigation into the available Soviet writings can help to illuminate the policies of the Soviet Union. A successful American nuclear strategy must be capable of influencing Soviet behavior. Attempts to understand their behavior can be made through an analysis of their actions and available literature. Interpretation of Soviet strategy

is not without its difficulties. The Soviet Union's emphasis on maintaining strict secrecy from its own people and from the outside world concerning all aspects of events and policies provides a stark contrast to the freedom of information available in the U.S. In the Soviet Union, secrecy is also combined with organized deception as a national policy to promote and enhance their objectives.

As mentioned above, a significant point in the evolution of U.S. strategy was the recognition of the existence of a uniquely Soviet doctrine. Marxist-Leninist ideology provides the major guidelines for Soviet doctrine. To briefly summarize, exploitation by Imperialists is the cause of the problems in developing countries. Resistance to imperialism in the underdeveloped countries, aided as possible by the Soviet Union, will continue to grow. This resistance combined with the inherent contradictions of capitalism will eventually cause its demise. As the end nears for capitalism, the capitalists will initiate a violent struggle to maintain power. Soviet belief in the dialectic nature of history assures them of the eventual triumph of socialism.

A major doctrinal reorientation of the Leninist tenet of inevitable war was expressed by Khrushchev in 1956 at the 20th Party Congress. He asserted that the global balance of power was changing in favor of socialism, and as a result, the "peace forces" might be capable of preventing the West

from "unleashing war." Although war was no longer considered fatally inevitable, the struggle between socialism and capitalism would continue. [Ref. 8:pp. 83,84] However, the possibility of nuclear war cannot be ruled out --especially as a possible desperate non-rational attempt by imperialism in its death throes.

A nuclear weapons policy has been incorporated into the ideology of Marx and Lenin. Although nuclear weapons have changed the character of any future war, the Soviets believe nuclear weapons have not altered the political essence of war. Nuclear weapons can provide the critical means of winning the war should a conventional only option prove ineffective. Soviet nuclear strikes would be decisive, but would also require the follow-up of combined arms offensives for the successful prosecution of a protracted war. A nuclear war would require the employment of all arms, conventional and nuclear, to attain final victory.

Soviet doctrine portrays a survivable nuclear war with an attainable and meaningful victory. They have rejected the "absolute weapon" notion so common in the United States. The capability to wage a nuclear war in terms of military preparation (offensive and active and passive defenses) is a major element of a visible Soviet deterrent, but it does not indicate an inclination toward regarding nuclear war as a rational instrument of policy. Rather, such deterrent policies are designed to minimize the incentive for

attacking the Soviet Union. This is how John Erickson describes the Soviet concept of deterrence by denial--designed to prevent the United States from the initiation of hostilities, to minimize the incentives for attacking the USSR by guaranteeing counterstrike, and to assure the survival of the Soviet system. Thus, the Soviet goal of war-prevention is contrasted with the U.S. attitude of war-avoidance and the 'unthinkability' of war. [Ref. 9:pp. 245-249]

For the Soviets, deterrence stresses both offensive and defensive goals. The Soviets have a massive program of both active and passive defense. Casper Weinberger describes the Soviet deterrent as "not simply to deter any attack against themselves, but to erode the deterrent character of U.S. nuclear forces." [Ref. 3:p. 24] There does not appear to be a distinction in Soviet doctrine between deterrence and the capability to fight a war [Ref. 10:p. 210].

The position that war would be suicidal for both parties has been espoused by Soviet leaders but can be interpreted as an export philosophy. Inside the Soviet Union, such talk is generally denounced as "bourgeois pacifism." [Ref. 11:p. 30] The Soviets openly used the theme of a winnable nuclear war in their literature for many years until they recognized a changed perception by the West in the 1970s. Since then, public statements are intended to give the perception that they believe a nuclear war is not "winnable" but statements

still include comments that a nuclear war would be concluded on terms favorable to the Soviets. [Ref. 10:p. 216]

Although there is no way for the West to ascertain what would constitute unacceptable damage to the Soviet Union, Soviet writings indicate that they expect to suffer large numbers of casualties in the event of a nuclear war. Richard Pipes quotes General Bochkarev:

> The fundamental line of our Party is expressed with utmost precision and clarity: if imperialism commits a crime and plunges mankind into the abyss of nuclear war, imperialism will perish, and not "both sides," not socialism, although the socialist countries, too, will face supreme tests and suffer immense losses. [Ref. 12:pp. 56,57]

This idea of victory, even under the recognized devastation of an undesired World War III, encompasses expectations that the United States tends to deem incompatible with a meaningful concept of victory. The Soviet's criteria for victory includes regime maintenance, recovery and reconstruction, and the destruction of the U.S. war-waging potential . [Ref. 8:p. 137]

The Soviet Union has declared a "no first use" policy. A closer examination of military writings reveals significant subtleties of this declaration. If the Soviet Union determined that an attack was imminent, it would not hesitate to launch a preemptive first strike. Soviet strategists stress the importance of surprise and the need to be prepared at all times to disrupt a surprise attack by the aggressors. "By going first, and especially disrupting command and control, the highest likelihood of limiting

damage and coming out of the war with intact forces and a surviving nation is achieved, virtually independent of the force balance." [Ref. 13:p. 164]

The Soviets do not desire a war, especially if their objectives can be achieved through other means. They fully recognize the persuasiveness of military might in foreign interactions. As Brezhnev reportedly predicted (looking to 1985) in his 1973 Prague speech, "we will be in a position to impose our will with impunity, not only in Western Europe but in other areas of interest."--giving the reasons for this as deployment of a new generation of strategic weapons and the successful Soviet influence in the Third World. The value of superiority in quantitative and qualitative military forces, designed to fight and win a war, not only provides the best deterrence, but it also influences daily international politics. The Soviets believe that the nation with the most credible doctrine will determine the direction of international politics. [Ref. 14:pp. 127,128]

Conflict and contradictions in policy have not been evident in Soviet war planning as they have been in the West. What is known of Soviet nuclear strategy has remained essentially unchanged in the nuclear era. The targeting priorities are: 1) nuclear delivery systems; 2) military installations; 3) military industries; and, 4) centers of political-military administration, command and control [Ref. 15:pp. 138,139]. The Soviet literature does not support

targeting cities or leaving Soviet cities open to a Western assured second-strike. Active defense of the homeland is a strong theme. [Ref. 10:p. 212]

The Soviet Union is consistent in its stable, long-term view of its security problems. Weapons acquisition is guided by party policy designed to satisfy the requirements of military doctrine and strategy. The Soviet Union has persisted in a sustained drive to acquire balanced offensive and defensive forces. There appears to be a good match between declaratory strategy and force capability. They have not experienced the inconsistent allocation of defense resources characteristic of the West.

For the Soviet Union, deterrence is one-sided; they must make war unprofitable for the West. ". . . deterrence is stable only when USSR nuclear and non-nuclear forces are superior--not when they are equal to those of the West." [Ref. 15:pp. 23,24] This deterrent philosophy allows no room for the concept of mutual vulnerability. Soviet political attitudes perceive the Western concept of strategic stability as a reliance on the rationality of the adversary. Such a mutuality would imply dependence on the adversary for Soviet security and is an unacceptable approach for a nation which emphasizes security through superior force. [Ref. 9:p. 243] Richard Pipes offers an additional reason why a large military force is essential to the Soviet Union; ". . . military power serves not only (or

even primarily) to deter external aggression, but also and above all to ensure internal stability and permit external expansion." [Ref. 5:p. 29]

C. SUMMARY

The U.S. and Soviet nuclear policies of the past 40 years have each shown characteristic features, indicating some degree of consistency in the factors guiding the decision making process of each country. In order to investigate how the U.S. and the Soviet Union might respond to the new scientific research surrounding the nuclear winter hypothesis, the past and present policies were presented above in terms of the deterrent role of nuclear weapons in maintaining national security.

In summary, nuclear weapons have been central to the U.S. deterrence philosophy since 1945. Deterrence philosophy in the United States consists of two major schools of thought--'assured destructionist' and the traditional military approach to war. The traditional military approach has been the dominant influence on the operational war plans of the United States. Declaratory policy has evolved from an emphasis on assured destruction to a policy of selective targeting options and a secure second-strike force with assured destruction as a last resort.

It is noted that the assured destructionist's view of war--no meaningful victory in a nuclear war; nuclear weapons

provide mutual deterrence--is a common view held by the American public. Mutual assured destruction philosophy, although not an official policy, was the basis for the U.S. negotiating approach to the SALT I talks, illustrating a lack of appreciation for Soviet doctrine at that time. The coexistence of these two conflicting philosophies in the United States has created situations characterized by a mismatch of declaratory and operational policy, and of a mismatch of declaratory policy and capabilities.

Soviet nuclear doctrine has exhibited a consistency in objectives which has guided the steady increase in Soviet military capability. Soviet doctrine portrays nuclear war as survivable with a meaningful victory attainable, in spite of the recognized devastation which is possible. War is not inevitable, but an irrational act by the West may cause deterrence to fail. A massive, counterforce, preemptive first-strike would be launched by the Soviets if they determined that a strategic nuclear attack by the West was imminent.

The capability to wage a nuclear war in terms of military preparation (with nuclear weapons providing the critical means of winning a war), is a major element of the Soviet deterrent. Both offensive and defensive goals are stressed by the Soviets. Mutual vulnerability is not a part of Soviet doctrine. Deterrence is considered stable only when Soviet nuclear and non-nuclear forces are superior.

The value of superiority in military forces not only provides the best deterrence, but also influences daily international politics in favor of Soviet objectives.

With the above setting of nuclear policies in mind, the question of incorporating new information on the consequences of nuclear war into policy will be examined. Chapter II will describe the fragmentary nature of our knowledge of nuclear weapons' effects--with the newest scientific investigations directed at the nuclear winter hypothesis. The evolution of this hypothesis will be presented to emphasize the validity of the concern over possible long term climatic disturbances and the consensus of plausibility for the hypothesis which has developed within the scientific community. The possible global nature of the effects and the wide-ranging biological implications for ecological disaster will be presented as the basis for the several unique aspects of the hypothesis which have stimulated debate over nuclear policy issues.

Chapter III will present the primary policy issues generated in the West by the hypothesis under the broad categories of: 1) Deterrence (enhanced or questioned?); 2) Relations with allied and nonaligned countries; 3) Nuclear arsenals; 4) War fighting capabilities, targeting and strategies; 5) Crisis management and control efforts; and, 6) Civil defense. These issues will be presented in light of the nuclear backdrop presented in this chapter.

The observed responses of the United States and the Soviet Union to the nuclear winter hypothesis will be examined in the fourth chapter. The U.S. response, in terms of Congressional hearings, studies sponsored by government agencies, Department of Defense (DOD) statements, and allotted funding for continued research, provides indicators of future actions.

The Soviet beliefs and intentions surrounding actions in response to the nuclear winter hypothesis will remain a matter of interpretation and speculation. Chapter IV will discuss the exploitation potential of the nuclear winter issue.

The final chapter will provide speculation as to future response actions of the United States and the Soviet Union to a hypothesis which has acknowledged plausibility for previously unappreciated long-term devastation to the earth's ecological balance--if a nuclear war occurs. This speculation will be based on an appreciation for the nuclear policies by which each country has managed to avoid a nuclear war thus far.

II. EVOLUTION OF THE NUCLEAR WINTER HYPOTHESIS

Nuclear weapons are essential to the deterrence philosophy of maintaining national security for the Soviet Union and for the United States. It might at first be assumed that considerations for the use of such an important device and its effects would be fully understood. This, however, was not the case when atomic weapons were first used against Japan in 1945. Knowledge of nuclear weapons' effects remains fragmentary with many uncertainties in spite of the importance placed on them for defense and in spite of the large world nuclear arsenal.

Much of the advancement in knowledge of nuclear weapons' effects was accomplished via accidental discoveries, always impressing and occasionally surprising nuclear scientists and engineers. The short-term effects were first studied following the 1945 detonations. A fair amount of knowledge on the blast and heat effects is now available giving rise to many estimates of the number of immediate fatalities from a nuclear war.

The 1954 Bikini Atoll tests brought recognition of the danger of distant radioactive contamination. Many uncertainties remain concerning radioactive contamination--for example, tests are still ongoing to determine ways to minimize the amount of active cesium in the food chains at

Bikini Atoll so that the displaced Marshallese can safely return. The incidents at Three Mile Island and Chernobyl highlight the widespread concern for uncertainties which still exist. Other previously unappreciated revelations of nuclear weapons' use have included the Van Allen belt effects, the electromagnetic pulse (EMP) and its effects on electronic communications, and the effect of injection of nitrogen oxides into the ozone layer.

With the growth of the arsenals, scientists became concerned that global environmental effects might occur if a nuclear war were to occur. Such concern led to projects like Gabriel and Sunshine--from 1949 through 1959--to evaluate the danger of radioactive fallout. A 1965 study undertook a broad analysis of the environmental and biological consequences of nuclear war, including the effects of blast, fires, and fallout. These early studies were hampered by a lack of critical data and inadequate technical means to analyze vast amounts of data. [Ref. 16:p. 185]

More recently, two of the major studies on nuclear weapons' effects produced are: 1) The 1975 National Academy of Science report on Long Term World-Wide Effects of Multiple-Weapons Detonations, which centered on the recently identified ozone depletion problem; and, 2) The 1979 U.S. Office of Technology Assessment study, The Effects of Nuclear War, which focused mainly on the immediate

consequences with long term effects centered on cancer and genetic diseases.

Scientific research began to look comprehensively at the potential long term climatic and environmental damage of a nuclear conflict in the 1980s. A new variable was introduced into the study of nuclear war effects through a series of related investigations--the variable of particulates, massive amounts of smoke and dust injected into the atmosphere as a result of nuclear detonations.

In 1980, scientists investigating the mass extinction of the late Cretacious period (65 million years ago), used geologic evidence to support their proposal that a huge cloud of dust caused by a meteor impact could have led to the extinctions. Scientists considered that dust raised as a result of nuclear explosions may be analogous to dust from such a meteor impact.

During this same period, Carl Sagan and his colleagues were working with the National Aeronautics and Space Administration (NASA) interpreting data from Martian dust storms being sent back to Earth from Voyager 9. It was realized that the analytic tools used for studying Martian dust storms were applicable to the analysis of smoke and dust on Earth.

Although the destructive potential of fires had been realized during World War II in Hamburg, Dresden and Hiroshima, the smoke from such fires had never been

considered as a factor which could bring about serious, long term, after-effects of a nuclear war. The main study which introduced the idea of potentially severe climatic consequences from large sooty smoke inputs was by P.J. Crutzen and J.W. Birks, entitled "The Atmosphere After a Nuclear War: Twilight at Noon," which appeared in Ambio, an international journal of the human environment published by the Royal Swedish Academy of Sciences. Crutzen and Birks calculated that several million tons of thick smoke would rise from all the fires started by a nuclear exchange. They estimated that the smoke would cloud the atmosphere of the northern half of the Earth and block sunlight from its surface for several weeks. [Ref. 17:pp. 114-125]

The Crutzen and Birks study led to increased interest and further quantitative investigation. The particular studies chosen for review in this chapter provide a summary of the research over the past five years with consideration given to the most significant work that has been conducted. Investigations have become more sophisticated and complex over the years. The atmospheric computer modeling used for such studies has passed from relatively simple one-dimensional, radiative-convective models, through three-dimensional global models with fixed uniform smoke distributions, to fully interactive models, in which smoke is injected and allowed to be dispersed by and interact with atmospheric circulation, and to models which allow the

infinite heat capacity of the oceans to affect the atmosphere. The conclusions presented below are representative of the scientific consensus to date.

The atmospheric models used to investigate the environmental effects of nuclear winter share common assumptions. These assumptions include:

1. Nuclear war occurs in the Northern Hemisphere.

2. Nuclear explosions create and loft dust particles and cause fires that would release considerable quantities of smoke. Smoke from massive fires (started most effectively by low-yield air bursts[2]) would be injected primarily into the troposphere[3]. Washout of particles can occur due to rain in the troposphere. (Scavenging is the term used to include the processes of washout of particles and of coagulation of particles.) Dust from ground bursts which vaporize, melt and pulverize the earth's surface at the target area, would be propelled into the upper troposphere and stratosphere. Dust in the stratosphere falls out much more slowly.

3. The addition of the particulates (dust particles and smoke) in the atmosphere will decrease the transmission of solar energy to the earth's surface, caused by the backscattering effect of dust particles and smoke's high absorptive properties for solar radiation. [Ref. 19:pp. 10,11]

---

[2]The blast effect from an air burst will affect a larger area than a ground burst, thus increasing the potential to start fires over a larger area. [Ref. 18:p. 9]

[3]The troposphere is the lower region of the earth's atmosphere (up to approximately 13 km.), wherein most weather phenomena such as turbulence, precipitation, etc., occur. Above it is the stratosphere, characterized by a very stable density distribution and mild turbulence.

A. TTAPS REPORT

The TTAPS report[4], prepared by research scientist Richard Turco, astronomer Carl Sagan, and three atmospheric scientists from NASA's Ames Research Center in California, used computer models to investigate the impact of dust and smoke in the atmosphere. The term 'Nuclear Winter' was coined by Richard Turco to express the general predictions by such computer models of darkened skies and reduced surface temperatures (especially in summer) brought about by the smoke and dust injected into the atmosphere from nuclear detonations. The earth's surface would cool as a consequence of the smoke in the upper atmosphere absorbing solar radiation. The burning of cities, due to their greater concentration of fuel and combustibles, is of greatest concern in the production of massive amounts of smoke. [Ref. 20:pp. 1283-1292]

The TTAPS study used a one-dimensional atmospheric model. Such a model departs from reality in that the variation of atmospheric properties and processes are treated only in the vertical direction, there is no latitudinal or longitudinal variation in geography (the underlying surface of the earth is taken to be a uniform land surface) or in any of the atmospheric quantities. Assumptions were made as to the type of war scenario and the

---

[4]The acronym is formed from the first letter of the last name of the scientists who prepared the report: Turco, Toon, Ackerman, Pollack and Sagan.

resultant amount of smoke from fires. The model was used to portray the injection of the smoke into the atmosphere, the removal process, and the resultant temperature changes at the earth's surface.

Several different war scenarios were investigated, covering a wide range of possible wars. The scenarios ranged from limited to large-scale attacks (involving 75 percent of the world strategic arsenal) and they included counterforce and countervalue strikes. Many computer runs were made on each scenario to investigate the range of uncertainty on each of the key parameters (e.g., the amount of smoke injected into the atmosphere). The baseline war scenario consisted of a 5000 megaton (Mt) exchange of which 20 percent of the yield hit urban or industrial targets.

The results indicated that extremes of temperature drops to minus 30^{o}-40^{o}C could be reached in a few weeks after an exchange. The baseline scenario results indicated that a temperature minimum of -23^{o}C is reached within a few weeks, and temperatures return to the freezing point after about three months. Recovery to normal temperatures was estimated to take more than a year because of the slow fallout of the stratospheric dust. [Ref. 18:p. 18]

Although many of the later popular accounts of this new theory failed to properly emphasize the uncertainties, the TTAPS authors recognized and fully admitted the uncertainties and weaknesses of their study. They presented

the limitations of their study, due to the limitations of the model used and assumptions made, indicating that some uncertainties would tend to work toward more severe effects and others would tend to ameliorate the effects. One of the limitations of the model was the inability to address the transport of the particulates in three dimensions. Smoke and dust were assumed to be uniformly distributed over the Northern Hemisphere at the start of the calculations. The one-dimensional study speculated that the smoke and dust would be transported away from the northern midlatitudes to involve the equatorial zone and the Southern Hemisphere. The smoke-transport problem also leaves unaddressed the possible ameliorating effects of clear patches where the smoke does not occur. The effects of the ocean (which in reality contain a large supply of heat) were not addressed nor was the local atmospheric circulation near coastlines and implications for rainout. It was speculated that a drastically altered structure of the atmosphere may change the lower troposphere into a more stable area, such as occurs in the present stratosphere, which would then hinder the conditions that might otherwise cause the rainout of particles. [Ref. 18:pp. 20-24]

Carl Sagan expanded upon the initial quantitative data of the TTAPS study to pose additional disconcerting ideas. These concepts included: 1) the possibility of the extinction of the human race; 2) a suicidal first-strike

which is adequate to set off a nuclear winter; and 3) a threshold can be stated, above which nuclear wars would cause the onset of the nuclear winter conditions (placed at between 500-2000 warheads). [Ref. 21:pp. 35-49]

B. NATIONAL RESEARCH COUNCIL REPORT

In 1983, the Department of Defense sponsored additional research conducted by the National Research Council (NRC). The study was overseen by the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The report, published in 1985, was given the most extensive and critical review ever accorded an Academy study. The value of this study comes from its clear presentation of the nature and extent of uncertainties surrounding the investigations of atmospheric effects.

The baseline scenario used 6500 Mt, with 1500 Mt detonated at ground level and 5000 Mt detonated at altitudes chosen to maximize blast damage. Of this 5000 Mt, 1500 Mt was directed at military, economic and political targets that coincidentally lie in or near about 1000 of the largest urban areas. This scenario became the basis for many subsequent analyses. A set of mid-range scientifically plausible baseline physical parameters (e.g., how much smoke is produced), were chosen to calculate the environmental effects of the nuclear exchange. The TTAPS model was applied to this baseline case in order to relate the results of both studies and to compare the TTAPS report to the NRC

baseline when multidimensional modeling was used. The rainout removal rate profile provides an example of the different assumptions initially made in both studies. The TTAPS group chose baseline values designed to represent the rainout characteristics of the unperturbed atmosphere. The NRC values were modified so that faster rainout occurs in the lower troposphere (0 to 5 km) and no rainout occurs above 5 km in an attempt to simulate possible effects of changes in static stability. [Ref. 16:pp. 136,137]

The NRC report concluded that it was not possible to estimate the most probable average temperature changes at the surface caused by injected smoke and dust. Any single value would be meaningless due to the large uncertainties of many of the physical parameters, limitations of the models used for computer simulations, and the probable wide range in seasonal and geographic differences. [Ref. 2:p. 8] In general, the report agreed with the TTAPS study, concluding:

> A major nuclear exchange would insert significant amounts of smoke, fine dust, and undesirable species into the atmosphere. These depositions could result in dramatic perturbations of the atmosphere lasting over a period of at least a few weeks. Estimation of the amounts, vertical distributions, and the subsequent fates of these materials involves large uncertainties. Furthermore, accurate detailed accounts of the response of the atmosphere, the redistribution and removal of the distributions, and the duration of a greatly degraded environment lie beyond the present state of knowledge.
>
> Nevertheless, the committee finds that, unless one or more of the effects lie near the less severe end of their uncertainty ranges, or unless some mitigating effect has been overlooked, there is a clear possibility that great portions of the land areas of the northern temperate zone (and perhaps a large segment of the planet) could be severely affected. Possible impacts include major

temperature reductions (particularly for an exchange that occurs in the summer) lasting for weeks, with subnormal temperatures persisting for months. The impact of these temperature reductions and associated meteorological changes on the surviving population, and on the biosphere that supports the survivors could be severe, and deserves careful independent study. [Ref. 16:pp. 6,7]

The NRC study presented the uncertainties in a context which improved an understanding of their impact. It provided a thorough review of the existing knowledge and provided the necessary qualifications to the conclusions that could be drawn. The manner in which the study was presented stressed the complexities of the problem and attracted further interest by the scientific community.

C. SCOPE REPORT

The International Council of Scientific Unions (ICSU) includes 20 disciplinary international scientific unions and 66 national academies including those of the United States, the Soviet Union, China, the United Kingdom, France, and others. In 1982, ICSU tasked its Scientific Committee on Problems of the Environment (SCOPE) to "prepare a report for wide dissemination that would be an unemotional, nonpolitical, authoritative and readily understandable statement of the effects of nuclear war, even a limited one, on human beings and on other parts of the biosphere." [Ref. 22:p. 52] The SCOPE findings were released in two volumes in late 1985, the first covering the physical and atmospheric effects with the second covering biological and other ecological effects.

The volume on atmospheric effects provides a comprehensive synthesis of results from existing research. By the time this study was published, modeling had advanced to the point that simulations portrayed the interaction between the absorption of solar radiation by the smoke particles and atmospheric motions, smoke dispersion from its initial source as opposed to uniformly distributed smoke as an initial condition, and scavenging rates determined by more advanced computations. In summarizing the status of the climatic consequences of a nuclear war, the report states that "No new and substantial work (as opposed to some qualitative expressions of criticism) has lessened the probability that a major nuclear exchange would cause severe environmental effects. . . ." [Ref. 2:p. 196]

The overall conclusions, which represent a strong consensus of hundreds of scientists from over 30 nations involved in the project, are as follows:

1. Average Northern Hemisphere land surface temperatures, beneath dense smoke patches, could decrease by 20°-40°C, below normal, in continental areas within a few days, depending on the duration of the dense smoke and the particular meteorological state of the atmosphere. During the initial period of smoke dispersion, temperature anomalies could be spatially and temporarily quite variable while patchy smoke clouds strongly modulate the insolation reaching the surface.

2. For spring to early fall injections, solar heating of the particles could rapidly warm the elevated smoke layer. The warming could stabilize the atmosphere and suppress vertical movement of the air below these layers.

3. Strong solar heating of smoke injected into the Northern Hemisphere between April and September would

destabilize the atmosphere and increase the vertical motion of the air above those layers, thus carrying the smoke upwards and equatorward.

4. Average summertime land surface temperatures in the Northern Hemisphere midlatitudes could drop to levels typical of fall or early winter for periods of weeks or more with convective precipitation being essentially eliminated. [Ref. 2:pp. xxxiv-xxxvi]

It is noted that many of the conclusions support the speculations made in the earliest studies.

D. NCAR REPORT (1986)

The National Center for Atmospheric Research (NCAR) has been involved in this type of climatic effect studies for several years. The most recent study by Thompson and Schneider [Ref. 23:pp. 981-1005] indicate less severe reductions in surface temperatures than indicated in previous studies. These findings are related to the use of three dimensional interactive models, and a revision of the assumptions concerning the amount of dust and smoke injected into the troposphere and stratosphere. The study uses more conservative assumptions of low altitude smoke injection and of more rapid smoke washout. Results indicate that minimum July temperatures in the northern mid-latitudes would range between 7^{o} and $12^{o}C$, with coastal areas experiencing little effect. This significant mitigation of surface cooling reflects considerations for the large heat capacity of the oceans, a more rapid removal of smoke (75 percent in 30 days), and the infrared greenhouse effect caused by the

smoke. The ocean effect is the major factor. [Ref. 24:p. 619]

Although the predictions indicate smaller immediate effects (within 1-30 days) the scientists speculated that the long term effects (months to years) could be worse than previously anticipated. Long term effects might include the onset of a late spring and early fall as well as possible disruption of the monsoons. [Ref. 24:p. 620] Such effects could greatly hamper agricultural recovery efforts.

E. LLNL REPORT (1987)

The Lawrence Livermore National Laboratory (LLNL) has also been involved in climatic studies for the past several years. A recent study supports the previous speculation that precipitation patterns might be altered. Performed under the auspices of the Department of Energy, this study examined the global-scale response for a summertime (July) scenario. A two-level tropospheric general circulation model was applied to the scenario and run for 30 days. The findings indicate that land precipitation is very sensitive to the amount of smoke injected into the atmosphere. Significant reductions in summertime precipitation may occur for even small smoke injections. The sensitivity in the midlatitude summer may be due to the reduced surface evaporation caused by suppressed mixing of the surface air with the upper tropospheric air. The authors caution that results may be model-dependent. This particular model is

extremely limited in its vertical resolution. This criticism points out a concern for the type of model used, its sensitivities and resolution. Such concerns must be considered in an evaluation of any atmospheric study. [Ref. 25:pp. 38,39]

F. OCEAN RESPONSE MODEL (1987)

As the above studies indicated, the oceans have been found to play an important role in the atmospheric simulations. Models capable of realistically including the effect of the ocean's large heat capacity on the atmosphere predict less severe temperature reductions at the earth's surface. This study, in which a model atmosphere provided the forcing (winds and heating) to a model ocean, investigates the response of the ocean's mixed layer to the hypothetical atmospheric effects of a major nuclear exchange. An examination of the ocean's response to a "nuclear winter" is important because of the possibly large feedback processes that might occur. Such feedback processes would involve the complex interrelationships between the sea-surface temperatures (SST), energy fluxes, precipitation, and cloud formation. [Ref. 26:pp. 9,10]

The atmosphere was represented by a two-level general circulation atmospheric model in both a control and a nuclear winter simulation. The ocean was represented by a one-dimensional mixed layer model applied at six different locations in the North Atlantic and North Pacific oceans.

The results indicate that the upper ocean experiences a significant cooling (several degrees centigrade) in response to a large scale nuclear war depending on the distance of the point in question from the nearest source of smoke. This study investigated the short-term (30-day) response of the ocean. The authors do not speculate on the significance of the results. [Ref. 27:pp. 1967-1974] This study is included because it portrays an additional consideration for the complex interactions of the earth's climate systems.

G. BIOLOGICAL CONSIDERATIONS

The research presented thus far has focused on investigating the effects a nuclear war might have on the earth's atmosphere and ocean. A discussion of the risks of nuclear war would be incomplete without stressing the direct association a change in the earth's climate might have on the earth's ecosystems. Any combination of the nuclear winter effects (reduced sunlight, temperature, or rainfall) that are considered plausible as a consequence of nuclear war would impact the primary producers in the food chain upon which all organisms, including man, are dependent.

Although research on the potential biological and agricultural implications that could arise from a nuclear winter scenario has been limited to date, that which has been conducted attempts to address the following key issues: 1) Effect of sustained low light on plant physiology; 2) Plant stress response to an unnatural sudden or slow

temperature decrease; and 3) Recovery ability of the ecosystems [Ref. 28:p. 24]. The biologists' problems in addressing such concerns are considered even more perplexing than those of the physical scientists studying climatic effects. The biologist must deal with a mosaic of ecosystems that cannot be easily described mathematically. [Ref. 29:p. 576]

The possible effects of nuclear war consequences to the physical environment on particular species has been investigated over the past few decades.[5] Volume II of the SCOPE findings, "Ecological and Agricultural Effects," represents the most comprehensive study conducted dealing with the possible impact of atmospheric and climatic changes proposed by the nuclear winter concept. As mentioned earlier, the SCOPE report is a culmination of nearly two years of work and the efforts of hundreds of scientists from over 30 nations. The conclusions of the SCOPE report include:

- Natural ecosystems are vulnerable to climatic disturbances with differential vulnerability. Temperature effects would be dominant for terrestrial ecosystems in the Northern Hemisphere and in tropics and sub-tropics; light reductions would be most important for oceanic systems; precipitation effects would be more important to grasslands and many Southern Hemisphere ecosystems.

- The potential for synergistic responses and propagation effects through ecosystems implies much greater impacts

---

[5]Examples of such research include: Fosberg 1959, Beatley 1966, Romney et al. 1971, Whicker and Schultz 1982, Hansen et al. 1983, and Harwell 1984 [Ref. 29:pp. 576-583].

than indicated from investigating any single disturbance.

- Recovery of natural ecosystems from the climatic stresses would depend on normal adaptations to disturbance (i.e., presence of spores, seed banks, vegetative growth). For some systems the initial damage would be very great and recovery unlikely. Human-ecosystem interactions could retard ecological recovery.

- Natural ecosystems have limitations in the amounts of utilizable energy they provide. Natural ecosystems cannot replace agricultural systems in supporting the majority of humans on earth.

- As a consequence of the above fact, humans are highly vulnerable to disruptions in agricultural systems.

- Agricultural systems are very sensitive to climatic and societal disturbances occurring on regional to global scales, with reductions in or even total loss of crop yields possible in response to many of the potential stresses.

- The high sensitivity of agricultural systems to even relatively small climatic alterations impart devastating consequences to even the lower estimates of nuclear winter effects.[6]

- As a consequence of the potential disruptions in agricultural productivity and in the exchange of food across national boundaries in the aftermath of a nuclear war, the majority of the world's population would be at risk of starvation. [Ref. 31:pp. xxxi-xxxiii]

Although physical scientists have identified factors that could increase or decrease the severity of climatic changes, biologists and ecologists have pointed out that an average temperature drop of even a few degrees and short-term "quick freezes" could eliminate one or more

---

[6]One scientist participating in the SCOPE study stated, "From the biologists' standpoint, even if the physical scientists are wrong by a factor of 10 or maybe even a factor of 100, we're still talking about a catastrophe." [Ref. 30:p. 540]

crop-growing seasons and injure or kill tropical species. Paul Ehrlich has commented that much ". . . uncertainty in the debate is dampened by the extraordinary sensitivity of living organisms." [Ref. 32:p. 5]

H. UNCERTAINTIES IN THE NUCLEAR WINTER HYPOTHESIS

The studies reviewed give an indication of the advancements which have been made in applied atmospheric modeling. There are still, of necessity, many simplifications and assumptions of physical processes made in the models. Although the uncertainties may be reduced by further research, they will not be eliminated. A discussion of the major uncertainties follows.

1. Adequacy of the Atmospheric Models

As mentioned earlier, each model has its own limitations. It is the sensitivity and the resolution of the models which generate most of the scientific criticism of any particular study. The most highly resolved models are more physically comprehensive. Simpler models may help to illustrate basic physical principles and the relative importance of individual factors, while the more comprehensive models are used to provide geographic detail or interactive processes. The most reliable procedure is to repeat climatic sensitivity experiments using several different models and constantly compare the results. As mentioned in the SCOPE report, this approach has been used

by many independent climatic modeling groups, culminating in the synthesis of results presented in their report.

The complexity of the models and the expense of running the highly sophisticated computer programs has resulted in the majority of studies being limited to only the short-term effects, i.e. approximately 30 days. Scientists stress the importance of additional studies which would address long term effects, as computer capabilities expand.

The atmospheric models necessary to research the climatic effects of a nuclear exchange have many other contemporary applications (e.g., ozone depletion and acid rain studies). The high interest in these combined areas will surely add to the continued demand for improved modeling.

2. Properties of Smoke and Dust: How Much, How High, How Long?

Naturally occurring events, such as volcanic eruptions and large forest fires, help determine plausible estimates of smoke and dust properties. However, as analogies their usefulness must be qualified. For example, a volcanic eruption produces particulates of a much different chemical composition than does a fire. These differences will affect the transport and absorptive properties. While accounts of "the year without a summer," following the Tambora eruption in 1815, provide some possible clues, it must also be noted that such accounts do

not qualify as scientific data. Without such data it is impossible to discount other factors, such as naturally occurring climatic variation, which may have caused the cool temperatures following the eruption.

Data obtained from observing forest fires has been used to estimate the amount of smoke produced and the physical properties of such smoke. It is noted that the burning of cities will produce the largest amounts of smoke due to the greater concentration of combustibles. For plausible smoke estimates, one must first consider the expected fire development and spread characteristics. This determination will be dependent on the yield and burst point of the nuclear weapon, weather conditions, fuel distribution patterns, etc.

3. The Nuclear War Scenario

The human choices which determine the strategy of a nuclear war will remain an unknown. The early studies started with a hypothetical war scenario. The TTAPS study was criticized for using individual weapon yields which were too high, and not representative of today's arsenals. The NRC study corrected this part of the war scenario. Subsequently, the war scenarios used have been accepted as being plausible, given our knowledge of the U.S. and Soviet Union strategies. The more recent studies differ from their predecessors in starting with a hypothetical quantity of smoke and dust in the atmosphere rather than a hypothetical

war scenario. It is suggested that this change reflects an emphasis on the scientific approach--what happens once the particles are in the atmosphere. One of the authors of the TTAPS study, Carl Sagan, was quick to express policy implications--more easily addressed when one's study speaks in terms of units used for arms control negotiations, e.g., numbers of warheads.

The war scenario will determine the numbers and yields of weapons, how the weapons are targeted (geographical locations, as well as height from surface), and when the war occurs (the season and prevailing weather conditions at the time). Thus, the war scenario will be a major factor in determining the parameters concerning the physical properties of the smoke and dust particles, the scavenging process, and the transport.

I. SUMMARY

The scientific literature reviewed in this chapter represents some of the major studies in the evolution of the nuclear winter hypothesis. The review was intended to provide not only a summary of the research but also to illustrate the wide number of scientists and institutions involved in this area of ongoing investigation.

Valid scientific criticism of the studies centers on the assumptions and uncertainties, and the need for refinement. Criticism of another non-scientific nature has frequently focused on comparing the results of the TTAPS report to

those of the more recent NCAR study, without a full understanding of either work. Apparently these criticisms are an attempt to disparage the entire nuclear winter hypothesis by focusing on an incomplete intepretation of one of the first reports.

Although the recent studies, most notably the NCAR research by Thompson and Schneider, have concluded that the climatic change would be more mild than initially proposed in the TTAPS report, thus lessening the apocalyptic forecasts, all of the studies confirm the basic principles of the hypothesis. There has been no scientific research which refutes the likelihood of climatic change as a consequence of nuclear war. All studies indicate a consensus of plausibility of the nuclear winter hypothesis. All studies also state that the impact of the climatic change, even in the modest range, would cause catastrophic consequences to the ecology of our earth. The uncertainties involve the degree of severity of the nuclear winter effects.

The evolution of the nuclear winter research reflects the evolution of computer and modeling sophistication. Although the research has shown significant refinement, the number of uncertainties discussed point out areas for continued research. A key concept in attempting to understand the possibilities is to recognize the uncertainties of the many independent variables and to

recognize the many unknowns surrounding synergistic effects. This understanding has led scientists to conclude that the concept of a threshold (a number of warheads or megatonnage, above which nuclear war would cause the onset of nuclear winter and below which no nuclear winter would occur), was a product of simplified models, and in fact, no such threshold can be stated at the present time. Many scientists have indicated that if a threshold could be stated it should most likely be stated in terms of the amount of smoke, soot, and dust particles injected into the atmosphere rather than in numbers of warheads or megatonnage [Ref. 28:p. 17].

The nuclear winter research has only been able to indicate the range of possible environmental effects and has indicated that such effects must be given serious consideration as a severe consequence of nuclear war. It must be recognized that some uncertainties will always remain. The ongoing research will continue to provide the plausible range of consequences and a necessary assessment of one more dimension of the risks of nuclear war.

Advancements in science and technology now offer policy makers information on the effects of nuclear weapons which were not available when the nuclear powers formulated their policies of national security based on nuclear weapons. The next chapter will present the variety of policy issues which are being questioned in response to the new information embodied in the nuclear winter hypothesis.

III. THE POLICY ISSUES

The nuclear winter hypothesis, since its initial debut in the TTAPS report, continues to generate debate over the link between scientific research and policy regarding nuclear weapons. A wide variety of policy implications have been proposed by a wide variety of commentators, reaching widely divergent conclusions.

The interpretations have ranged from declaring that the nuclear winter hypothesis demands a strategic revolution to declaring that nuclear winter offers nothing new--or that the uncertainties are too great to even consider implications for policy. Among some, there was a sense of hope that this new information would force the nuclear powers to limit, reduce and destroy their nuclear arsenals. Thomas Powers, responding to the TTAPS report, stated, ". . . the nuclear winter thesis, if valid, threatens to make nonsense of every notion the planners have managed to come up with, in forty years of trying to devise a sensible way to fight a nuclear war." [Ref. 33:p. 59] At the other end of the spectrum, the Office of Science and Technology Policy (OSTP) criticized a report submitted to Congress by the U.S. General Accounting Office (GAO) for its presentation of policy issues, stating, "The desire to answer policy issues without first understanding the basic

science associated with the climate tends to give more validity to the nuclear winter theory than is warranted." [Ref. 28:p. 52] This leads to the question of what criteria of basic scientific understanding should be reached before considering policy implications.

The nuclear winter hypothesis caused a flurry of policy debate because of its several unique aspects. It presents a consideration of long-term environmental effects which had previously been unanticipated. The initial TTAPS report stressed the possibility of the extinction of the human species. Although subsequent scientific research relegates the extinction of the human species to a very low probability, the research continues to stress the probable devastating environmental effects.

Another unique aspect deals with the possibility of a relatively small exchange, or even a one-sided preemptive attack, causing serious climatic change. This concept was most explicitly stated in the TTAPS study for a scenario involving a 100 Mt countervalue attack. Subsequent studies do not attempt to quantify the megatonnage, but the range of uncertainty still leaves room for the possibility of a relatively small attack setting off nuclear winter. The state of uncertainty is likely to remain with an unknown set of parameters determining a continuum of climatic deterioration.

The final unique aspect is the predicted global nature of the nuclear winter hypothesis. Countries not directly involved, and far removed geographically, were previously expected to suffer economic consequences of a Northern Hemisphere nuclear exchange. Climatic change would bring direct suffering to non-participants on a new scale. Some analysts feel that the increased probability of global human suffering places greater moral demands on nuclear powers to revise nuclear policy. The global nature of the consequences also increase the importance of the nuclear winter hypothesis as a foreign policy issue.

A 1986 policy study, commissioned by Dr. Richard Wagner, Assistant to the Secretary of Defense (Atomic Energy), and conducted by the Airpower Research Institute, Center for Aerospace Doctrine, Research and Education, investigated the policy implications of nuclear winter for a low, medium and high threshold, assuming that the level of nuclear combat threshold would eventually be usefully defined. The authors made several important assumptions: 1) Conflicts between states will continue to occur and the U.S. must be prepared to deter aggression or, should deterrence fail, be able to successfully prosecute military conflicts; 2) All current nuclear powers will have as an objective the prevention of nuclear winter; however, any nation might gamble with causing nuclear winter if faced with a desperate situation in which national survival was at stake; and, 3) When the

level of effort required to produce nuclear winter is defined, it will be universally understood and accepted. [Ref. 34:pp. 4,5]

Assumption one does not require the acceptance of a drastic change in world order leading to the cessation of international tensions that is often proposed by those who make radical proposals for disarmament. Assumptions two and three, however, are not likely to be realized in the scientific aspect or within the realm of differing objectives and doctrines of national security. The authors note this possibility and indicate that without the assumptions the "matrix for analysis becomes unwieldy and confusing." [Ref. 34:p. 5] This paper will not be based on the acceptance of assumptions two and three. It will, instead, be set in the present context of scientific uncertainty and uncertainty in knowing another nation's objectives.

Within this acknowledged "unwieldy and confusing matrix" the policy issues which have been proposed by policy analysts and scientists will be presented in this chapter. The policy issues surrounding the nuclear winter hypothesis, although prompted by new information and some unique concerns, are basically a continuation of concerns and questions of the past 40 years of the nuclear era. An analysis of the proposals must take into account a historical perspective of our pursuit for national security,

as well as an awareness of the Soviet perspective. In addition to responses intended to lessen the likelihood of climatic change as a result of nuclear war, other responses are made in response to the political implications for foreign policy which must be dealt with (as the theory becomes well enough known to affect world perceptions), whether or not the hypothesis is ever validated.

A. DETERRENCE

The goal of U.S. nuclear strategy is to prevent (nuclear) war by maintaining deterrence. U.S. deterrence policy is based on the survivability of strategic forces and the ability of these forces to inflict unacceptable damage on the attacker in retaliation. Does the nuclear winter hypothesis challenge nuclear deterrence in a unique way? The different responses to this question highlight the ambiguities which surround the concept of nuclear deterrence. There is, certainly, widespread belief in the effectiveness of nuclear deterrence--the general idea of which has remained reasonably constant in operational U.S. strategic thinking. The success of deterrence, however, cannot be proved. A nuclear war has not occurred in 40 years, but whether or not this fact can be attributed to the role of nuclear deterrence is an unknown. Thomas Schnelling, one of the best known early theorists of deterrence, commented in 1960 that,

> What is impressive is not how complicated the idea of deterrence has become, and how carefully it has been refined and developed, but how slow the progress has been, how vague the concepts still are, and how inelegant the current theory of deterrence is. [Ref. 35:p. 40]

The challenges the nuclear winter hypothesis has placed on the deterrence theory may not have raised new questions, but it has definitely emphasized a new look at old questions.

1. Deterrence Enhanced

The uncertainties of nuclear warfare were considered significant before the TTAPS report of 1983. The possibility of nuclear winter consequences adds to those uncertainties and supports the position that the unknown effects may be more important, and more harmful, than the known prompt effects. As the uncertainties of cost versus gain increase, the incentives to initiate use of nuclear weapons could be reduced for fear of escalation to a level of conflict causing the onset of nuclear winter. As already indicated, the level of conflict, or threshold, which will cause the onset of nuclear winter is likely to remain an unknown. Carl Sagan, noting the heavy forestation and urban density of central Europe, warns of the possibility that even a limited use of tactical nuclear weapons could bring about climatic change. [Ref. 36:p. 9] The increased level of uncertainty makes it more difficult for an aggressor to calculate the positive results from aggression and even easier to miscalculate those results. The absence of the

ability to calculate success would be interpreted as reinforcing deterrence by those who believe uncertainty enhances deterrence. [Ref. 34:p. 74]

The probability of environmental devastation, adding to the already contemplated horrors of war, could in itself act to deter a nuclear war. This perspective is easily accepted by the American public and is one of the underlying assumptions of those who propose drastic cuts in the nuclear arsenal. According to recent polls, some 80 percent of the American public expects that it would perish if a nuclear war between the United States and the Soviet Union were to occur [Ref. 37:p. 124]. Proponents of the "mutual assured destruction" (MAD) concept, who believe that nuclear weapons have no operational value as weapons of war, welcome the nuclear winter hypothesis as underlining the truth in their position--there is no defense and no escape from the devastation of nuclear war. In this perspective, the impact of self-deterrence becomes of increasing significance to U.S. declaratory policy which has exhibited, throughout the nuclear era, a significant emphasis on the assured destructionist school of thought. A nation which accepts the MAD philosophy will be deterred more easily; i.e., will be deterred from entering into conflicts by the fear of use of any (its own or the adversary's) nuclear weapons, regardless of the particular strategy and force structure of an adversary.

2. Credibility of Nuclear Deterrent Questioned

The U.S. deterrent policy, based on the ability to inflict unacceptable damage on the opponent and the capability to deny him his military-political objectives, requires adequate military forces and the perception (by the opponent) that the U.S. will use these forces. U.S. declaratory policy moved away from an emphasis on assured destruction as the deterrent because a choice between surrender or suicide was not credible. Nuclear winter is perceived by some as reason to challenge the United States' move toward an emphasis on a warfighting capability. If even limited nuclear use brings about devastating climatic change, the threat of use becomes less credible due to its suicidal consequences. If the United States' acceptance of the hypothesis increases the role of self-deterrence, as could be manifested in unilateral arms reductions, it is likely that the perception factor of credibility will be lessened in the Soviet Union's view of the U.S. nuclear deterrent.

An understanding of the perception factor of deterrence requires an appreciation of Soviet doctrine. Many commentators have written on the dangers of asymmetric acceptance of the nuclear winter hypothesis. The danger of asymmetry in doctrines has been with us all along, and will continue to be a problem even if both the U.S. and the Soviet Union accepted the probability of serious climatic

consequences following a nuclear exchange. Soviet deterrent attitudes do not include the acceptance of mutual vulnerability. It is very unlikely that the Soviet Union would involve itself in any actions which would increase its (perceived) vulnerability to the West. On the other hand, it would surely exploit any such "weakness" evidenced by the West.

3. The Onset of War

The above discussions describe a pre-war world where calculations and risk assessment are conducted. Such descriptions characterize the "rational" model for the onset of war as proposed in the book Hawks, Doves and Owls by Allison, Carnesale and Nye. The authors propose two models, the deliberate (or rational) and the inadvertent. These two paths to war are likely to be influenced differently by the nuclear winter hypothesis. As indicated, nuclear winter is likely to have contradictory effects on the rational model.

The second model, that of inadvertent war, stresses the importance of non-rational factors occurring in a crisis situation. In a crisis condition, political leaders would be under great psychological stress, and would have little time to cope with the effects of any accidents, misperceptions or organizational breakdowns that might occur. These stress factors would probably outweigh the role of careful calculations and the consideration of such consequences as nuclear winter. If this is true, then it does not appear

that nuclear winter would be a significant factor entering into the probability of a nuclear war under the crisis situation. [Ref. 38:pp. 120,121]

Indeed, most all of our detailed considerations of deterrence failure might be irrelevant in the inadvertent model which becomes overpowered by non-rational factors. However, this does not negate the grave importance of our current system of stability. Our system influences the day to day outcome of foreign relations and provides us with the existing safeguards to decrease the likelihood of war.

4. And If Nuclear Winter Deters the Use of Nuclear Weapons . . .

The final perspective on deterrence that will be presented is one in which it is speculated that the nuclear winter hypothesis may have such a significant impact that the use of nuclear weapons would be considered an unacceptable option. Conflicts between states will continue to occur and will require a nation to be prepared to deter aggression. Deterrence, then, would be based on conventional forces, and this approach demands that the West strengthen its conventional forces.

Conventional force improvements for NATO were under consideration prior to the advent of nuclear winter concerns. Budgetary considerations were a key factor in acceptance of a NATO policy which relied on nuclear weapons, and they continue to be the key reason for the lack of expanded conventional capabilities. It is generally agreed

today that trends are taking place that are changing the conventional balance in a direction favorable to the Warsaw Pact. The balance of Soviet forces, both nuclear and conventional, is an important characteristic of the Soviet threat. Whether or not nuclear weapons continue to be viewed as an option, improved conventional forces should be pursued to avoid being merely a "trip-wire" to a nuclear exchange and to provide the West with a balanced and credible deterrent.

B. RELATIONS WITH ALLIED AND NONALIGNED COUNTRIES

In the past, many countries could look at the prospect of a nuclear exchange between the United States and the Soviet Union without feeling that they would be directly involved. The nuclear winter hypothesis indicates that climatic change would be global, with all nations experiencing environmental consequences. Regardless of the scientific conclusions, other nations now have a keen interest in how the nuclear powers, particularly the United States and the Soviet Union, address the issue.

The nuclear winter hypothesis is likely to increase the already existing ambivalence about the American nuclear guarantee to Europe. Acceptance of the nuclear winter concept could strengthen the link between the U.S. and European security by substantially decreasing the possibility that the U.S. and the Soviet Union could escape devastation by confining a nuclear war to Europe, and

therefore decreasing the possibility of war. Alternatively, the link could be weakened if it is perceived that the U.S. and Soviet Union would confine any aggressions in Europe at the conventional level. This would still have disastrous consequences for Europe but would avoid triggering a global nuclear winter. This perception could contribute toward producing a (further) crisis of confidence within the NATO Alliance. [Ref. 39:p. 16] The dilemmas of extended deterrence are not substantially changed but the problems of confidence within the NATO Alliance could be heightened. The Soviets could take advantage of this situation to gain leverage over the U.S. and to exacerbate existing tensions.

Southern hemisphere countries have also expressed concern. Notably, scientists from Australia and New Zealand have conducted their own research with specific emphasis on the atmospheric alterations in the southern hemisphere. Australia and New Zealand would be about the least severely affected countries because of the less severe effects in the southern hemisphere and because of the normally large food surpluses. An Australian scientist speculates, ". . . we would likely be almost the only surviving organized societies. . . ." which leads him to coin the term 'Lifeboat Australia'. [Ref. 40:p. 24] Russell Seitz, a fellow at Harvard's Center for International Affairs, offers frequent criticism of the methods and results of the nuclear winter research. Seitz claims that the popular version of nuclear

winter is partly responsible for the antiweapons movement in Australia and New Zealand. [Ref. 41:p. 271]

Another point of view on policy and foreign relations was expressed in a memorandum for Admiral Watkins which summarized a March 1985 NAS symposium on nuclear winter. The author of the memorandum, a U.S. Navy Captain, stated, "While the fact that Nigeria or Brazil or other nations will be damaged in a nuclear exchange is irrelevant to military planning, it has implications for peacetime foreign policy. There is much which needs to be done here, but not by the Department of Defense." [Ref. 42:pp. 1,2] This view neglects the impact that statements from the Department of Defense and a knowledge of military planning can have on foreign policy. If the U.S. appears reticent and the Soviet Union appears to be responsive to the devastation implied by the research, the Soviet Union will have made positive gains in world opinion. The implications for U.S. foreign policy should take into consideration the significance of Third World activities as viewed by the Soviet Union. Lenin spoke of the Third World as "the weak link in the imperialist chain." The Third World countries continue to be significant to Soviet ambitions.

Some analysts speculate on another foreign relations aspect of nuclear winter. Recognizing that there may be areas in the southern hemisphere less affected by environmental damage following a war, these areas would be a vital

source for post-war reconstitution needs. Our actions now might help determine the willingness to offer resources later. However, determining an outcome can be accomplished diplomatically or through coercion. Perhaps the belligerent nation with a surviving nuclear force would receive the best response in acquiring 'aid' in its reconstitution efforts.

Expressions of concern over nuclear winter have not been as numerous as might have been expected initially, but they are in evidence. "The Delhi Declaration" of January 28, 1985, signed by Argentina, India, Mexico, Tanzania, Sweden and Greece stated: "Nuclear war, even on a limited scale, would trigger an arctic nuclear winter which may transform the Earth into a darkened, frozen planet, posing unprecedented peril to all nations, even those far removed from the nuclear explosions." [Ref. 23:p. 1005] Although the declaration expresses an extreme version of nuclear winter which might be considered unrealistic in scientific terms, the possible impact on foreign relations is a reality. The SCOPE meetings provided an excellent forum for generating international awareness. Subsequently, the United Nations has had two resolutions introduced that express interest in gaining additional scientific knowledge on the nuclear winter hypothesis.[7]

---

[7]These include U.N. #A/C.1/39/L.22 "Resolution on Nuclear Winter," introduced by India, Mexico, Pakistan, Sweden, Uruguay and Yugoslavia; and #A/C.1/39/L.69/Rev. 1, "Studies on Climatic Effects of Nuclear War Including the Possibility of Nuclear Winter," introduced by Belgium,

C. NUCLEAR ARSENALS

The nuclear winter hypothesis implies that the use of man's nuclear weapons technology could result in devastating changes to the physical and biological processes which have evolved over the earth's history of approximately 4.5 billion years. The hypothesis introduces the prospect of creating conditions that would inhibit even the most optimistic reconstitution outlook. If man created the technology that threatens his own survival, cannot man control that technology and remove the threat? The answer of how to control the technology ranges from attempting to disinvent it, to attempts to improve upon it.

1. Arms Reduction

Arms control has played an increased role of importance in U.S. strategic policy since the U.S. lost is unquestioned nuclear superiority in the 1960s. As increasing Soviet capabilities were gradually acknowledged, the role of arms control increased in importance in the U.S. view of maintaining peace. According to U.S. conventional wisdom, the emergence of National Technical Means (NTM) particularly space-based reconnaissance, enhanced monitoring skills to the point that meaningful arms control agreements were possible. It is not surprising that arms control would again be invoked to help resolve the concerns of nuclear winter effects. Any evaluation of the success of arms

---

Canada, the Federal Republic of Germany and Japan.

control must take into account the objectives and intentions of the participating countries as well as the difficulties involved in achieving acceptable compliance and the limitations of the NTM.

Carl Sagan feels that his research points ". . . to one apparently inescapable conclusion: the necessity of moving as rapidly as possible to reduce the global nuclear arsenals." [Ref. 18:p. 11] Using his estimated threshold of 500-2000 warheads results in requiring a 90 percent reduction. This reduced arsenal would be ". . . of the same order as the arsenals that were publicly announced in the 1950s and 1960s as an unmistakable strategic deterrent and as sufficient to destroy the U.S. or the Soviet Union 'irrecoverably'." [Ref. 21:p. 51] This reasoning illustrates a minimal deterrence philosophy which perceives changes in the strategic balance of the past 20 years as inconsequential. It ignores strategic modernization, the need for a survivable strategic reserve, and a Soviet doctrine which does not accept the Western view of assured destruction. In general, proponents of massive reductions believe: 1) a nuclear war cannot remain limited but will quickly escalate to an all-out exchange; 2) mutual assured destruction is what deters; and 3) there is no significance to strategic superiority.

Despite the importance of a stated threshold for establishing policy, the present scientific consensus is

that a threshold cannot be stated--particularly not in terms of numbers of warheads, i.e., the unit used in current arms control negotiations. The inability of scientific research to state a threshold does not lessen support for reductions, since those who propose such suggestions equate fewer weapons with less likelihood of war. Criticisms of massive arms reduction proposals include the following:

- it would be difficult to verify exactly what level of reductions had been made.
- it might be perceived that nuclear war would be safer to wage given reduced arsenals, or the prospects of waging a conventional war might be more likely.
- other nations might choose to strive for superpower status by attaining or increasing nuclear capabilities, thus creating greater world instability. [Ref. 28:pp. 30,31]

A major consideration in arms reductions must be the Soviet objective. If they do not share the same goal, and do not perceive deterrence in the same manner, the U.S. would likely be faced with an inequitable agreement or even unilateral reductions. Concerns over avoiding a nuclear winter may play a role in future arms control negotiations by further lessening the U.S. consideration for nuclear superiority. Such agreements would inevitably affect U.S. vulnerability and must be viewed as to what effect the changes would have on increasing the probability of war.

2. New Technologies

A different perspective, which attempts to maintain present stability without drastic changes in the world

system, suggests incorporating the implications of nuclear winter into present force planning through continued modernization efforts. This involves the reduction of the older, higher yield stockpiles and a trend to low yield, high accuracy weapons. A reduction in total megatonnage and of total yield of individual warheads results. It is often erroneously believed that efforts to modernize the U.S. nuclear stockpile have led to an escalating yield and number of weapons. In fact, the exact opposite is true. The relative total yield of the U.S. stockpile in 1985 was reduced fourfold from its peak value in the mid-60s. Modernization played a major role in reducing the yield of the stockpile. This reduction is largely the result of increased accuracy of the delivery systems. In the past, high yields were preferred as the means of destruction against hard targets. Increased accuracy has made it possible to develop and deploy warheads of lower yield. [Ref. 43:p. 11]

Among the new technologies frequently cited are earth-penetrating weapons (EPW) and enhanced-radiation weapons (neutron bombs). Warheads detonated at the surface expend most of their energy in the air and relatively little in producing the ground shock needed to affect deeply buried structures. The EPW couples a larger fraction of its energy into the ground than does a surface-burst weapon, thus the enhanced ground-motion effects are more effective against

highly reinforced or deeply buried targets. [Ref. 44:p. 4] The EPW would be an effective weapon against hardened silos and would also minimize fires, soot and stratospheric dust.

The neutron bomb, conceived and partially developed by American scientists in the 1960s, depends mainly on penetrating radiation for its destructive power instead of relying on blast and fire. The amount of dust, soot and smoke which contribute to creating a nuclear winter would be greatly diminished. The prospects of production of the neutron bomb were stimulated in the 1970s as the Soviet ground threat in Europe became more pronounced. Even at this time, prior to nuclear winter research, the neutron bomb should have been more acceptable to the people of Western Europe as it was far less indiscriminate in its destructive power and was specifically designed to concentrate its effects on the attacking troops without leaving radioactivity on the ground. [Ref. 45:p. 211] The fact that the neutron bomb was not produced and deployed, can be attributed at least in part, to one of the most successful Soviet propaganda operations waged since World War II. The basic theme of the propaganda was that the neutron bomb would pose a grave threat to detente, require a retaliatory Soviet response of building mass annihilation weapons, and be extremely destabilizing. [Ref. 46:pp. 343-374]

The Strategic Defense Initiative (SDI) has been presented as a means of avoiding the potential for a nuclear winter. The Department of Defense argues that the possibility of a nuclear winter increases the need for SDI. It is obvious that the possibility of nuclear winter occurring would still exist with SDI unless, as President Reagan suggested, the technology is shared, for detonations on any continent might produce global atmospheric changes. Additionally, concerns for damage caused by missiles, cruise missiles, and bombers leaking through would still exist. Uncertainties surrounding the technical and deployment feasibilities of SDI indicate that it would be premature to consider SDI as a solution to nuclear winter concerns. Such considerations prompted Joseph Nye to state, "While it may be popular politics to invoke current fads and fears to support existing programmes, it is not good analysis, and SDI must rest on its merits or faults, and not on invocations of nuclear winter." [Ref. 38:p. 124]

The major argument against a reliance on new technologies centers on its possible destabilizing nature and the possibility that an increased arms race could ensue. Although this argument cannot be ignored, the example of the influence of Soviet propaganda on the neutron bomb should be kept in mind. Western opinion has typically been over-sensitive to the question of stability while the Soviets have pursued their force goals relatively unencumbered by

such concerns. Herman Kahn sums up the situation with a definition of 'arms control' as any steps that contribute to the objectives of diminishing the likelihood of war and to reducing the damage of war should deterrence fail. Sometimes a "safer" world can be achieved through arms buildups, sometimes through arms reductions, but it cannot be achieved by disinventing nuclear weapons. [Ref. 47:p. 193]

3. Nuclear Proliferation

Nuclear winter findings could increase the urgency for preventing the further proliferation of nuclear weapons. Nuclear proliferation was voiced as a concern by scientists even before the first nuclear detonation by the U.S. in 1945. While proliferation has been slower to this point than many anticipated, there is no guarantee that the future will continue so. If a very low nuclear winter threshold were accepted as valid, this could provide a strong incentive for nations to acquire nuclear weapons, even on a small scale, to gain political leverage by threat of nuclear blackmail. [Ref. 39:p. 30] Nuclear powers may take a more aggressive approach at inhibiting proliferation.

The Treaty on the Non-proliferation of Nuclear Weapons (NPT) has been signed by approximately 125 nations. In essence, the NPT asks nations without nuclear weapons to accept a trade-off: in return for a commitment to forego nuclear weapons, they would receive full cooperation and

assistance in developing peaceful civilian uses of nuclear energy from the nations that do have nuclear weapons. Under Article Six of the NPT, nuclear weapon states are committed to undertake arms control negotiations leading to "cessation of the nuclear arms race at an early date." [Ref. 48:p. 224] This is an area likely to become more controversial in the future, with more pressure being exerted for serious arms control efforts. Because nuclear winter raises a qualitatively new threat to countries outside the direct line of fire between the leading nuclear powers, the issue may add to any existing concerns by other nations regarding what many see as limited progress toward arms reductions and disarmaments. If other countries take this as an issue, world opinion may be generated to create greater influence for arms negotiations. Due to the nature of our open, democratic society, it is likely that such conditions would place greater pressure on the United States, and may lead to the U.S. acceptance of an inequitable agreement.

D. WARFIGHTING CAPABILITIES, TARGETING AND STRATEGIES

Recognizing the possibility of the failure of deterrence demands efforts to limit the consequences. Some strategists are likely to consider the immediate destruction resulting from an all-out 'spasm' war to overshadow any considerations for the long-term effects of nuclear winter. The possibility of limited nuclear attack options should not be discounted. Nuclear winter concerns may enhance the prospects of

intra-war escalation control. In the limited nuclear war scenario, the threat of climatic catastrophe clearly offers additional considerations for strategies and targeting.

In addition to terrestrial limited nuclear options which would mitigate conditions conducive to the creation of nuclear winter effects, other war scenarios can also be considered. War in space, occurring above the Earth's fragile atmosphere, would not produce the dust and smoke perturbing factors of the nuclear winter hypothesis.

Nuclear war limited to the sea would produce negligible amounts of smoke particles and thus would also provide a warfighting option non-conducive to nuclear winter effects. Although these options can be considered 'safe' from the nuclear winter aspect, they, of course, carry with them their own detrimental consequences.

The nuclear winter hypothesis may be interpreted as having too many uncertainties to drive major changes in targeting doctrine at this stage. It would, at least, be prudent to give some consideration to targeting strategies that avoid attacks on targets in urban/industrial areas (areas of most concern for fire and production of greatest amounts of smoke). The Department of Defense officially states that the United States does not target cities. This response does not address the proximity of specific targets to cities. This response does not address the proximity of

specific targets to cities. The current version of the SIOP (Single Integrated Operational Plan) reportedly includes some fifty thousand potential target installations divided into four principal groups--Soviet nuclear forces, general purpose forces, Soviet military and political leadership centers, and the Soviet economic and industrial base. [Ref. 49:p. 80] The large number of potential targets indicate the certainty that urban areas would be involved.

The Flexible Response strategy (selective targeting with minimized collateral damage and escalation control) was adopted by the U.S. as a more credible deterrent to the earlier strategy of massive retaliation. Selective targeting would obviously be less conducive to precipitating conditions causing a nuclear winter than massive retaliation--but would selective targeting minimize damage (i.e., fires and creation of dust) adequately to ensure nuclear winter would not occur?

Nuclear winter concerns intensify the doubts about controlling nuclear war (be it on land, at sea or in space) that have plagued even the advocates of flexible nuclear targeting. If the environment of nuclear war is incompatible to the "finely tuned" responses envisioned in U.S. declaratory policy then the assured destruction school of thought surfaces once again. [Ref. 50:p. 94] Even a successful strategy of limited nuclear options may involve unavoidable collateral damage conducive to the onset of a

nuclear winter. The TTAPS report addressed this issue with their mix of war scenarios, one of which was a 3,000 Mt counterforce only exchange. Of course, there are no definite answers--but more concerns are raised surrounding the ability to adequately minimize damage when the possibility of creating a nuclear winter is added to the risks of nuclear war.

Additionally, a "controlled" nuclear war would reflect "limited" actions by all nuclear powers involved. The Soviet view of a controlled or limited war apparently differs from that of the U.S. If nuclear war appeared inevitable to the Soviets, many analysts believe the Soviets would launch a massive, preemptive counterforce strike. A one-sided massive Soviet strike, which would have a high probability of containing targets in or near cities, could bring about nuclear winter conditions even if the U.S. adhered to a strategy of selective targeting.

Arms control agreements which limit launchers and warheads, even if complied with, would be inadequate to remove the threat of nuclear winter. Agreements on targeting restraints have also been suggested. Acceptance of an agreement to avoid targeting cities would achieve favorable propaganda value because of the sensitive moral issue as well as a means to lessen the chance of nuclear winter. Such an agreement would, however, be a hollow gesture that is truly non-verifiable.

At present, U.S. planners do not consider the smoke and dust creating potentials of given target types or of the nuclear winter implications of particular warheads to be detonated at specific altitudes over those targets. There is no data base or analysis methodology for assessing these potentials. [Ref. 39:p. 18] However, such data would be necessary if a nation were to evaluate their targeting options with nuclear winter in mind.

Since the U.S. and Soviet Union are not alone in the nuclear weapons community, other nations' targeting strategies must also be considered. Available French strategic writing tends to belittle counterforce concepts, stating that anti-city attacks are the only true deterrent. Most British and French strategic forces are believed to be targeted on cities and command targets. Chinese nuclear weapons are probably intended for relatively large population centers in central and eastern Russia. [Ref. 51:p. 89]

Clearly, any nation which does accept targeting restrictions out of concern for nuclear winter would be decreasing their nuclear options. An emphasis would have to be placed on designing limited nuclear attack options to minimize climatic effects and to maximize potential for achievement of policy goals. [Ref. 39:p. 18]

In terms of the strategy used to initiate a nuclear conflict, some policy analysts have speculated how one side

might use nuclear winter for strategic advantage. An aggressor might see an advantage to limiting a nuclear attack marginally below a threshold, gambling that the risk of exceeding the threshold would prevent the attacked nation from retaliating. [Ref. 28:p. 33]

This speculation assumes a common belief in the hypothesis in general, and in a specific threshold. The nuclear winter research, to date, indicates that a specific threshold does not exist. Instead, the dependency of the atmospheric and ecological response to a level of nuclear detonations is a continuous function. A recognition of the unknown synergistics effects within the complexities of the environment led researchers to this conclusion. Some policy analysts have revealed a tendency to overlook the present scientific consensus on this point. Acceptance of the concepts that no specific threshold exits and that a strike on one nation will also bring adverse effects to the attacker, mitigates a first-strike advantage as specifically related to nuclear winter effects. Other perceived advantages cannot be discounted however.

Some research indicates that locations close to the source of smoke will experience adverse climatic effects more quickly and more severely. This might be perceived as a strategic advantage if the attacker is willing to gamble on his own eventual risks. A nation's assessment of its own nuclear winter risks would be founded on very uncertain

scientific data but could consider more confirmed research as to the vulnerabilities of agricultural systems. A country in the more northerly latitudes, and with less diversity of crops (i.e., the Soviet Union), would experience more agricultural damage with a smaller change in climate. The scientific uncertainties leave a great deal of room for the role of perceptions to continue to influence strategies.

Nuclear winter adds to the concerns of warfighting capabilities as to how not only to 'control' the war, but whether or not command, control, communications and intelligence (C3I) assets will function in a perturbed environment. For example, optical reconnaissance satellites may be effectively blinded as soot fills the Earth's atmosphere. Erosion and friction effects of an upper-altitude soot layer on outbound missiles could possibly cause damage and/or gross inaccuracy. [Ref. 36:p. 13]

It is in this area of concern, that most nuclear winter related R&D efforts for military applications are likely to be directed. The military's interest in nuclear weapons' effects has throughout its history been a demonstrated concern for the disruption of military equipment and operations in contrast to goals directed toward protecting the environment. [Ref. 51: p. 34] And indeed, a very important part of the U.S. nuclear testing program, and a responsibility of the Defense Nuclear Agency, is to test the

effects of nuclear weapons on a vast array of military equipment, with specific emphasis being given to the non-nuclear components of U.S. strategic weapon systems, warning sensors, and communications equipment which have to function in a nuclear environment. [Ref. 43:pp. 10,11]

Nuclear winter concerns may influence the strategic debate over whether or not to preempt C3I assets, but once again ambiguities abound. C3I assets as a priority for targeting could be interpreted as a way to cripple a foe's retaliatory capability with minimal nuclear winter effects. It is even suggested that obscuration effects may be irrelevant if C3I assets were attacked early. On the other hand, retention of C3I assets would allow a means of control and the option of conducting war termination efforts more easily. In either case, nuclear winter concerns could support the already strong incentives of the U.S. and the Soviet Union to build more enduring C3I systems. [Ref. 39:pp. 20,21]

E. CRISIS MANAGEMENT AND CONTROL EFFORTS

Crisis management and control efforts are seen as safeguards to prevent nuclear war--therefore they should take on greater importance as an incentive to prevent war due to the additional concern of nuclear winter. If deterrence fails--there should be a greater concern to have efficient and survivable crisis management which could aid in 'controlling' the war to reduce the likelihood of causing

the onset of nuclear winter. Efforts toward reducing the likelihood of nuclear war have included past agreements between the U.S. and Soviet Union such as the Hotline Agreement of 1963, the Hotline Modernization Agreement of 1971, and the Prevention of Nuclear War Agreement of 1973. The present Administration has endorsed additional DOD initiatives to improve crisis management. Although these efforts do not specifically address nuclear winter concerns, the objectives would be the same.

F. CIVIL DEFENSE

Debates over the deterrence impact of civil defense measures and their stabilizing/destabilizing influence range the gamut of perspectives. In the United States, the 1950s popularity of the fallout shelter faded with the growth of Soviet missile forces, realization of adequate shelter expense, and a growing feeling among the American public that protection measures were fruitless. The Soviets, on the other hand, have made substantial preparations to protect their political leadership, industrial infrastructure and general population.

Prospects of survival will obviously depend on the war scenario. Those who believe a Soviet attack would be a massive, surprise attack directed at population centers are probably correct in thinking that protection of the people in the target area would be unsuccessful. Protection

opportunities are more feasible if a limited counterforce attack is considered.

The possibility of a nuclear winter, in any attack scenario, requires a reevaluation of the possible post-attack environment. Those people who believe protection is impossible without the additional prospects of a nuclear winter see the added long-term effects as more convincing evidence of the fruitlessness of passive measures. Admittedly, all civil defense efforts have been aimed at survival from the prompt effects of nuclear weapons. The possibility of long-term effects should stimulate some contingency planning for stockpiling of larger, survivable supplies of food and increased awareness of countermeasures to assist survivors. When concentrating on environmental impacts that disrupt food production, consideration should be given to distribution of surviving food surpluses and awareness of basic survival skills. A protected means of seed storage would not only provide the beginning of new plant food but also a surviving variety for the possibility of introducing more resilient strains.

G. CONCLUSIONS

All of the policy issues presented have at least two opposing suggested solutions. The solution an analyst chooses is based on his interpretation of deterrence and on his view of the nature of the adversary. In this respect, the debate over policy issues surrounding the nuclear winter

hypothesis offers nothing new. The debate reflects the same range of interpretations, dilemmas and ambiguities as other salient issues of the nuclear era. This situation led Peter Sederburg to observe, "In comparison with the policy arena, the ambiguities of the scientific investigation resemble certainties." [Ref. 52:p. 4]

Although it has been suggested that nuclear winter related policies which declare restrained actions during a war may break down under a crisis situation (since the onset of war itself indicates a breakdown of a level of rational thinking)--the policies are important primarily in their day-to-day impact on foreign relations, and in their impact on the likelihood of a crisis situation arising.

Colin Gray suggests that any strategic policy analysis of these issues must:

- consider that extensive further study is unlikely to resolve key scientific uncertainties.
- consider that even if key scientific uncertainties are narrowed usefully, the phenomenon of nuclear war has to be treated as a range of policy possibilities, not as a single unique sequence of events.
- appreciate the implications of the fact that the climatic consequences of nuclear war are not likely to be within unilateral U.S. control. [Ref. 53:p. 87]

With regard to this last point, our policy actions must be made with an awareness of Soviet objectives and intentions. U.S. policy considerations must be scrutinized for their value in an interactive world--where U.S. actions are strongly influenced by both internal and external

forces, where our foreign policies affect world stability and where the perceptions of U.S. strength affect the actions of ally and adversary.

The next chapter will examine actions taken by the United States and by the Soviet Union in response to the nuclear winter hypothesis.

IV. THE RESPONSE

This paper has presented a view of the nuclear strategic framework within which United States and Soviet decisions are being made concerning nuclear weapons' policies. The scientific research surrounding the nuclear winter hypothesis provides new information on the effects of nuclear weapons' use which was previously unknown and therefore unavailable to decision makers. The scientific consensus on the plausibility of the nuclear winter phenomena and its possible long term devastating effects are weighting factors that can be used by decision makers in determining the risks and consequences of a nuclear war.

The wide range of policy issues surrounding the nuclear winter hypothesis indicate a diversity of interpretations on how the United States could best incorporate the new scientific information into its nuclear policies. Two major questions considered in discussing nuclear winter policy issues surface: what is the nature of the adversary?; and, what deters? These questions represent a continuation of the nuclear dilemma facing decision makers since the nuclear era began.

Having provided this background information, the actual responses made by the United States and the Soviet Union to

the nuclear winter hypothesis will be presented in this chapter.

A. THE U.S. RESPONSE

Following the TTAPS report in 1983 and early 1984, the Reagan administration refrained from making any comment on the nuclear winter issue. Initial responses from the President's Office of Science and Technology Policy were skeptical. Congress, however, indicating an acceptance of the validity of the hypothesis and a concern for its implications, took an early interest in the nuclear winter issue and initiated several actions.

1. Congressional Hearings

As a consequence of the TTAPS report, an informal hearing was conducted by Senators Edward Kennedy and Mark Hatfield in December 1983 which was organized by the Nuclear Freeze Foundation.[8] U.S. and Soviet scientists were present at the forum. They discussed the policy implications of the nuclear winter findings and generally agreed on the seriousness of the issue.

The first formal Congressional hearings on nuclear winter took place in July 1984. Richard Wagner, assistant to the Secretary of Defense for Atomic Energy, told the Joint Economic Committee that the Department of Defense was

---

[8]It is noted that Kennedy and Hatfield have long been advocates of the Nuclear Freeze movement and of the MAD philosophy in general.

taking a serious look at nuclear winter. Shortly after this hearing, it was reported that the Reagan administration had an interagency group working on a plan for a 5-year, $50 million research effort on nuclear winter. The agency materialized a year later with a smaller budget.

A hearing before the Subcommittee on Natural Resources, Agriculture Research and Environment was held in September 1984 on the climatic, biological and strategic effects of nuclear war. Statements were given by Carl Sagan, Stephen Gould (Professor of Geology, Harvard University), Edward Teller, Alan Hecht (of the National Oceanic and Atmospheric Administration [NOAA]), and Vladimir Aleksandrov (of the USSR Academy of Sciences).

It is significant to note the direct access Soviet scientists have to Western political leaders on the nuclear winter issue. Their potential ability to influence Western leaders is heightened by this direct contact.

2. Congressional Mandate for DOD Response

Congress' concern over the nuclear winter issue resulted in amendments to the Defense Authorization Act requiring a DOD response to the issue. Senator Cohen stated at this time, ". . . if we are to deal prudently and wisely with this question [of nuclear winter], we must know as precisely as possible what the effects of these weapons would be and how those effects should shape our policy." [Ref. 32:p. 4]

The resulting Section 1107 of the act ordered the Secretary of Defense to prepare a public report on nuclear winter and its policy implications. The report was to cover: 1) A detailed review and assessment of scientific findings on the consequences of nuclear war; 2) A thorough evaluation of implications for nuclear weapons' policies; 3) A discussion of how to incorporate such evaluations into policy; and, 4) An analysis of how nuclear winter is being studied. The report was to be submitted by Secretary of Defense Weinberger by March 1, 1985. [Ref. 32:p. 4]

Secretary of Defense Weinberger's report, "The Potential Effects of Nuclear War on the Climate," was submitted to Congress in March 1985 and provides a clear statement of the administration's formal position on nuclear winter policy implications [Ref. 26:p. 27]. The 17-page report provided a concise summary of the scientific literature and implied acceptance of the validity of the hypothesis. However, the report asserted that the prospect of a nuclear winter does not alter current nuclear policies. In fact, the report stated, the threat of nuclear winter supported every aspect of current policy--such as existing weapons modernization plans (with particular emphasis on the importance of SDI) and arms control policies.

The theme of the report is summarized in this statement, "The issues raised by the possibility of effects of nuclear war on the atmosphere and climate only strengthen

the basic imperative of U.S. national security policy--that nuclear war must be prevented." And, if deterrence fails, the current modernization program (e.g., low yield, high accuracy weapons), SDI efforts, and the strategy of flexible targeting options for escalation control, would lessen the likelihood of a nuclear winter occurring. [Ref. 54:pp. 10,12]

Congress was dissatisfied with the report. The report received heavy criticism because it contained little substantive discussion of even such practical issues as the functioning of military equipment in a perturbed environment. The report failed to follow Congress' directions in several respects including avoiding discussing the biological and environmental consequences of a nuclear war. A Freedom of Information Act request by Congress revealed the lack of any Pentagon document in which these consequences had ever been reviewed or their policy implications considered. [Ref. 32:p. 5]

Following Congress' receipt of the report, two Congressional hearings were held on nuclear winter and its implications. Committees involved were the Committee on Science and Technology and the Committee on Interior and Insular Affairs (March 1985) and the Committee on Armed Services (October 1985). Assistant Secretary of Defense Richard Perle was present at both hearings to strongly object to any criticism of DOD's report, stating that such

criticism missed the fundamental point of the administration's present policy--i.e., to avoid nuclear war [Ref. 55:pp. 151,151].

Congress mandated that the Pentagon redo the report. DOD was again tasked to focus on nuclear winter findings and potential policy implications.

The Pentagon's 1986 report, entitled "Technical Issues Update," addressed the policy implications of the nuclear winter hypothesis by stating that ". . . regardless of the outcome of our technical studies, the most basic elements of our national policy [to prevent nuclear war by maintaining and strengthening deterrence] remain unchanged." (emphasis added) The report went on to state that DOD has "an appreciation" for the significance of nuclear winter consequences as a result of targeting strategies and technical weapons' characteristics, but that the substantial uncertainties of the hypothesis precluded addressing such issues of strategic policy--"Thus, the current results and observations should not be used for planning purposes." [Ref. 56:pp. 1,5] Congress felt that DOD had fallen short of its required tasking once again. A 1987 DOD report on the effects of nuclear war is underway and expected to be available by late 1987.

The actions taken by Congress seem to indicate not only acceptance of the hypothesis' validity but also that Congress desires a response other than that received from

DOD. Certainly, DOD's statement that no policy changes are warranted is, in itself, a statement of policy. Congress appears to desire a DOD statement indicating a change of policy is warranted.

3. General Accounting Office (GAO) Report (1986)

The GAO responded to a request from Congress for a review of the scientific research pertaining to nuclear winter, to include consideration as to whether the research findings might justify changing defense policy, in their concise report of March 1986. The study was based on a review of the scientific literature and also on interviews with prominent researchers and policy analysts in the field. As noted in Chapter III, the GAO's discussion of policy issues was a source of primary criticism received from the Office of Science and Technology Policy (OSTP). OSTP felt that even a discussion of the issues was premature at this time. Overall, the report was credited as being well balanced and technically correct by the several administrative officials, scientists and other interested parties who reviewed it. [Ref. 28:pp. 42,43]

4. Research and Funding

As scientific interest in nuclear winter grew, the administration gradually began to accept the issue as an area that needed some attention. Preliminary assessments of policy implications have been produced for DOD--one under a Defense Nuclear Agency (DNA) contract to the Palomar

Corporation entitled "Implications of the Nuclear Winter Thesis," and another by the Air University Center for Aerospace Doctrine, Research, and Education entitled "Nuclear Winter and National Security: Implications for Future Policy." In order to present the issues, both studies were predicated on the assumption that nuclear winter is a possible outcome of nuclear conflict. Neither study is recognized by DOD as a definitive assessment of nuclear winter policy implications nor are they considered by DOD as providing a basis for action at this time [Ref. 28:p. 27].

The primary focus of the administration's reaction to nuclear winter has been to identify and develop a plan for researching the physical uncertainties of the issue. Several of the major scientific studies reviewed in Chapter II were funded by government agencies. The National Academy of Sciences (NAS) was requested to investigate the nuclear winter hypothesis by DOD and received funding from DOD in 1983. The NAS report is considered one of the most authoritative accounts on the scientific aspects of the issue. The Department of Energy's laboratories at Los Alamos and Livermore have been involved in nuclear winter research since 1983-1984.

The President's Science Advisor requested in February of 1984 that an interagency plan be developed for studying nuclear winter. NOAA took a lead role in setting

up the plans. As a result, the administration established the Interagency Research Program (IRP), in October 1985, to coordinate the research of the Defense Nuclear Agency (DNA), the Los Alamos and Lawrence Livermore National Laboratories of the Department of Energy (DOE), and the National Center for Atmospheric Research (NCAR) of the National Science Foundation (NSF).

The IRP basically continues the nuclear winter research efforts that have been ongoing since 1983 and that were funded by DOD, DOE and NSF. Funding will continue to come from the three agencies' budgets. Nuclear winter research, conducted primarily at Los Alamos, Livermore and NCAR, with some research being contracted to other laboratories, totaled about $3.5 million for fiscal year 1985, with an increase to about $5.5 million for 1986 and 1987. The outlook is for the funding to remain about the same over the next few years. However, some scientists question the adequacy of the funding, the ability of the IRP to set priority research and control funding effectively, and the administration's long term commitment to studying the issue. [Ref. 28:pp. 36,37]

Continued cooperation and sharing of scientific information with the Soviet Union is encouraged by Congress. In the Foreign Relations Authorization Act for fiscal years 1986 and 1987, Congress recommended that the President should propose, during any arms control talks held, that the

U.S. and Soviet Union jointly study the nuclear winter issue.

As of August 1987, a measure was under consideration in several committees of the House of Representatives which proposes that the U.S. and USSR enter into a joint, high-level scientific study to determine the long term and environmental effects of a nuclear exchange. The resolution (which would fall under the 1985 umbrella commitments agreed to during the Geneva summit covering scientific exploration with the Soviets) also recommends that such effects should also be considered in the nuclear weapons, arms control, and civil defense policies of the United States and the Soviet Union. [Ref. 57:pp. 1-3]

It would appear likely, from what is known (and unknown) of Soviet policy that this recommendation offers an excellent opportunity for Soviets to participate in and influence U.S. decision making without making significant contributions of information as regards their own policies or state of available scientific data.

5. Prospect for Policy Changes

The administration took the important step of initiating a plan for research. Beyond this step the prognosis for further policy-related action is poor. DOD statements provide a clear portrayal of the Administration's position--changes in U.S. nuclear policies (arms reductions,

targeting strategies, weapons technology, etc.) as a response to the nuclear winter hypothesis are not warranted.

The position of IRP's Coordinating Committee is that the basic research must be addressed before the policy issues should be discussed, and that any policy assessments are at least four to five years away. [Ref. 28:p. 26]

The GAO investigations involved contacting numerous officials within DOD and the military services. Based on these interviews the GAO concluded that these officials were very much aware of the nuclear winter issue but they neither planned nor contemplated any actions based on the hypothesis. GAO was told by an official of the Plans and Policy staff under the Joint Chiefs of Staff that no new policy guidance had been issued or was planned based on the nuclear winter issue. This same official stated that damage associated only with the immediate blast is assessed in considering the consequences of nuclear weapons' use. [Ref. 28:p. 26]

The administration has not translated nuclear winter concerns into policy changes. A partial reason for a lack of change, as indicated in OSTP comments, is due to the existing uncertainties in the scientific research. Other comments, particularly from DOD, indicate that increased certainty of the scientific research would still not be reason enough for policy changes.

B. THE SOVIET RESPONSE

DOD's 1986 "Technical Issues Update" was submitted to the Committee on Armed Services with a cover letter. Soviet perceptions of deterrence and of the nuclear winter hypothesis were key themes in the letter:

> Whether the Soviets will, in fact, be prevented from starting a nuclear war, depends ultimately on their views of what constitutes sufficient deterrence--not on our views. The case at issue, i.e. whether possible climatic effects make a difference, depends critically on the USSR's estimate of the implications of the posited phenomena.
>
> We cannot count on the Soviets being "self-deterred" by the prospects of climatic effects, because no one knows today to what extent the phenomena will occur and because we will probably never be confident of knowing the Soviets real views as they relate to deterrence. The observation would be true even if the scientific uncertainties were to be significantly narrowed. (emphasis added) [Ref. 58:p. 2]

As discussed in previous chapters, an appreciation for Soviet thinking has at times been lacking in U.S. policy planning. Any response to the nuclear winter hypothesis, in order to be effective and maintain U.S. national security objectives, must consider Soviet perceptions. This section will examine the Soviet Union's observed responses and the Western interpretations of the Soviet behavior.

1. Soviet Research

During the 1970s, the Soviets were involved in studies of Martian dust storms, as were U.S. scientists. Following the AMBIO article in 1982, nuclear winter research proceeded simultaneously in the U.S. and the USSR--prior to the focus of public attention aroused by the TTAPS report.

Soviet research took place at the Computer Center of the Academy of Sciences and at the Institute of Physics of the Atmosphere of the Academy of Sciences. Joint papers by U.S. and Soviet scientists have ben published since 1984. [Ref. 59:p. 198] Examples of joint research include the active cooperation between scientists at the USSR National Academy of Sciences and the U.S. government's own nuclear weapons' research facility at Lawrence Livermore National Laboratory, and participation by Soviet scientists in producing the SCOPE report.

Soviet scientists were the first to apply a three-dimensional model to the nuclear winter research. The Soviet climate model consisted of 'borrowed' U.S. models--a two-level global circulation atmospheric model and a thermodynamic model of the upper ocean. [Ref. 60:p. 29] Significantly, however, the three-dimensional model of V. Aleksandrov and G. Stenchikov did not produce the ameliorating effects later achieved in U.S. three-dimensional models which incorporate the moderating effects of the ocean. The research, published only in English, was initially proclaimed as an independent effort which supported the TTAPS results. Closer examination of the research by U.S. scientists, including Carl Sagan, resulted in comments to the effect that the study actually contributed very little to the research efforts and that it

was a seriously flawed and weak piece of work. [Ref. 60:pp. 29,30]

According to many U.S. scientists, Soviet involvement in nuclear winter research continues to contribute little to reducing theory uncertainties; primarily due to weaknesses in modeling capability. Computer technology has been an acknowledged area of U.S. superiority. Therefore, a scientific pursuit which relies on computer modeling would likely be of higher quality in the U.S. Priority assigned to the research (and hence availability of computer resources, funding and personnel) would also affect the quality of the research.

Regardless of the Soviets' level of sincere interest in nuclear winter, they are definitely interested in gaining computer knowledge. One objective does not necessarily exclude the other. The Soviets have requested the use of advanced U.S. computers to conduct nuclear winter research. The Soviets' request was denied. [Ref. 61:pp. 20,21] This denial was probably based on the fact that technology transfer would be a highly prized benefit to the Soviet Union of joint nuclear winter research. Such technology has direct application to improved weapons' technology and other military applications.

Some U.S. scientists have questioned the originality of Soviet research. Soviet studies have used Western data for war scenarios, megatonnage, and the physical parameters

of particulate matter. Soviet scientists have been unwilling or unable to make fire and smoke research data available. Specific information was requested by Carl Sagan at a 1983 conference to include data on particulate matter from Soviet nuclear weapon tests prior to the 1963 Limited Test Ban Treaty and information on particle size and absorption coefficients from large Siberian fires. Sagan also requested information on Soviet war scenarios. The request was not fulfilled. [Ref. 60:pp. 31,32]

Contributions from Soviet scientists at international conferences have also been labeled as mediocre and non-contributory to advancement of the hypothesis. Regardless of the Soviets' level of scientific interest in nuclear winter, such mediocre contributions follow the pattern of Soviet scientific "exchanges." The exchange is frequently sought from West to East with little information of value offered from the Soviet side.

2. Soviet Internal Coverage

Soviet internal media coverage has increased gradually with time. The 'telebridge' dialogue between American and Soviet scientists at the "Conference on the World After Nuclear War," held in Washington in late 1983, was given fragmentary coverage in the Soviet Union. The brief coverage was representative of published articles as well. However, since mid-1984, press coverage has become more extensive. It remains true, however, that many Soviet

publications on nuclear winter are produced primarily for a foreign audience: this includes the only Soviet book so far published on the subject, which comes in the international series of Mir [Peace] publishers (entitled The Night After . . .). [Ref. 59:pp. 202,203]

3. Soviet Reports for Export

Reference to nuclear winter effects by Soviets, in whatever format, have consistently portrayed the worst case situation of severe temperature drops with frequent references to verification of data by 'mathematical precision.' Soviet reports indicate the belief that even a very limited attack would likely trigger climatic devastation. The Soviets have linked the nuclear winter hypothesis to their "no-first-use" declaration and their public stance on arms control, specifically with reference to SDI. Whether the audience is Soviet or foreign the message consistently portrays the horror of nuclear war with nuclear winter predictions accepted as valid. [Ref. 61:pp. 21,22]

The Federal Broadcast Information Service (FBIS) provides several examples of Soviet worst-case reports. In January 1986, FBIS cited an English TASS dispatch carrying statements from a Soviet specialist in environmental physics, Kirill Kondratyev. He claimed, ". . . man can exist only in a definite temperature regime. Changes from warmth to cold will be so sharp [as a consequence of nuclear

winter] that a global ecological catastrophe will happen. Everything on earth will perish. . . ." [Ref. 62:p. u1]

Kondratyev goes on to make the link to an anti-SDI stance, "All this makes it possible to imagine how dangerous military actions in space are. The so-called 'Strategic Defense Initiative' means a possibility of nuclear explosions at earth satellite's altitudes, and hence an ecological catastrophe." [Ref. 62:p. u1]

The Soviets have also applied such extensions of the nuclear winter idea to conventional warfare. Nikita Moiseyev, Deputy Director of the Computing Center of the Soviet Academy of Sciences, cited by TASS stated,

> The mathematical models [of nuclear war] showed the earth enveloped in soot, impenetrable to sun rays, but only as a result of the use of nuclear weapons. An effect, similar to the 'nuclear winter' one, might also emerge as a result of the use of conventional weapons whose capacity is constantly increasing. . . . [Ref. 63:p. AA3]

The Committee of Soviet Scientists for Peace has devoted considerable efforts to analyzing and publicizing the catastrophic impact of nuclear winter on the Third World. A working group has been set up for this purpose, headed by the Director of the Institute of African Studies. A Western commentator has remarked that this may be an effort to counter an irresponsible attitude to the dangers of nuclear war on the part of some Third World nations. [Ref. 59:p. 204]

Alternatively, such emphasis may reflect the overall importance the Soviets place on the role of the Third World

in the socialist/imperialist struggle. Comments indicative of this interpretation can be found in the committee's writings, for example,

> . . . states which lease their territories [and] surrounding seas for American bases and other military facilities, and allow U.S. warships to enter their ports and patrol on their waters . . . may at any moment become involved in a nuclear conflict contrary to their national interest. [Ref. 64:p. 205]

Publicly, Soviet scientific spokesmen have wholeheartedly embraced the nuclear winter hypothesis. The highest level of Soviet scientific community and of the USSR Academy of Sciences publicly claim to believe in the likely occurrence of a severe nuclear winter in the event of a nuclear war. No divergent views within the Soviet scientific community have been revealed. [Ref. 60:p. 34] This presents a much different situation than in the Western scientific community where debates as to the uncertainties and ameliorating effects are ongoing.

4. Propaganda Value

The foregoing information has led many analysts to conclude that the Soviets use the nuclear winter issue mainly for propaganda purposes via the media and international forums [Ref. 28:p. 13]. DOD states this same position in their 1985 report to the Congress.

As mentioned in Chapter I, since the 1970s, the Soviets have altered their public statements about the "winnability" of nuclear war, probably as a result of their awareness of Western perceptions. Some commentators accept

the public statements at face value. Soviet reports which stress worst-case nuclear winter scenarios and the extinction of mankind are quite similar to the post-1970 public statements stressing the horrors of nuclear war even before an appreciation of long term climatic effects had surfaced. Accepted at face value, such statements would indicate a convergence toward the assured destructionist ideas prevalent in American public thought. Acceptance of the statements may also lead one to believe that Soviet military policy is based on MAD principles.

Such public statements are, however, at variance with the continuity in nuclear doctrine evident in Soviet research, development and deployment of strategic systems, and in the pattern of Soviet military exercises. Analysis of this evidence indicates a continuity of the Soviet war-fighting doctrine with strategic superiority as a goal. [Ref. 65:p. 33]

When Soviet offensive and defensive military programs are contrasted with public statements since the early 1970s, certain conclusions concerning Soviet objectives appear evident. These are: to deprive American exponents of mutual assured destruction substantial evidence of the Soviet's warfighting/damage limitation strategy and conversely, to provide support and some evidence for proponents of MAD that the Soviet military attitudes have

shifted to an appreciation for mutual vulnerability. [Ref. 66:p. 386]

The change in publicly expressed military doctrine on the consequences of nuclear weapons' use started with the 'peace' program initiated at the Soviet Party Congress in 1971. [Ref. 65:p. 32] The Soviet Union has a history of using propaganda as an instrument of foreign policy, particularly in its exploitation of 'peace' to combat the West. The Western quest for peace has provided the single most frequent theme to serve as a rallying point for propaganda attacks on the West.

From past experience (e.g., the neutron bomb issue) the West should expect the USSR to exploit any and all available situations to stir up controversy over nuclear issues among NATO allies and the international scene in general. The principal goals of Soviet overt propaganda and covert political techniques have remained consistent: to weaken the United States and NATO and to bolster the Soviet Union, thereby creating a favorable environment for the advancement of Soviet objectives. [Ref. 67:p. 39]

The threat of a nuclear winter heightens concern over nuclear weapons. By publicly stating their belief in the horrors of nuclear war and their desire for peace, the Soviets are creating a diversion from scrutiny of their own objectives and defense doctrines. The policies of Western democracies, on the other hand, are open to domestic and

international scrutiny and the resultant pressures of that scrutiny. Such pressures could lead to an environment favorable to advancement of Soviet objectives--such as a weakening of the NATO alliance due to nuclear controversies, or arms control agreements which hamper the West and benefit the Soviets.

While Soviet exploitation of the nuclear winter issue for propaganda purposes should come as no surprise to the West, there are many questions which still remain as to Soviet perceptions of the nuclear winter hypothesis. Exploitation of the issue for propaganda purposes does not preclude the possibility that the Soviet scientific community may, in fact, hold the same consensus of plausibility for the hypothesis as is held in the Western world. The significant point, however, is to recognize that the Soviet scientific establishment is a part of the Soviet state and Communist Party organization. Gorbachev, speaking of the need for a devoted Party attitude to assess current events and phenomena, stated in a 1984 speech, "It is necessary to actively draw our scientists and specialists and professional people into information and propaganda work. . . ." [Ref. 68:pp. 416,417]

Participation by scientists in international forums, publications of scientific research, etc., are all strictly regulated in the Soviet Union. The West is reading and hearing only information which the Soviet leadership wants

to be made available. Conscious choices of censorship or embellishments have been made by the Soviet leadership and can be considered to reflect to some degree their political objectives.

5. Impact on Nuclear Strategy

What is the impact of the nuclear winter hypothesis on the Soviet leadership decision making? It is worth noting that a very high percentage of Party elite have technical backgrounds and would be well suited to appreciate the scientific findings and the technical implications for military applications. As the GAO report concluded, there is no information to permit a firm assessment of how the Soviet Union leadership actually perceives the nuclear winter implications. [Ref. 28:p. 13]

To date, there is no indication that the implications of a possible nuclear winter effect have in any way influenced Soviet strategic doctrine or programs for the further buildup of Soviet strategic nuclear forces. The amount of interest given nuclear winter by Soviet scientists indicates that it is a significant issue in the Soviet Union. The significance of the propaganda value has been presented as being fully in line with continuing Soviet "peace" objectives.

The conclusion that the Soviets use the hypothesis primarily for its propaganda aspect is supported by: 1) The lack of originality in Soviet research; 2) The lack of

additional insights and contributions to furthering the research; 3) The consistent and unanimous portrayal by Soviet scientists and politicians of worst-case scenarios; 4) The applied linkage of the hypothesis to other themes which benefit the Soviet Union--no-first-use, anti-U.S. SDI endeavors; and, 5) The publication of nuclear winter literature primarily for a foreign audience (i.e., publications which only appear in English). Whether or not the nuclear winter hypothesis holds additional significance to the Party leadership and to Soviet military policies, will remain an issue of speculation.

It is, however, likely that a nation possessing a warfighting strategy would at least question the effects of the perturbed nuclear winter environment on the ability of its weapons to perform. Soviet analysts would question such new factors as to their impact on deterrence. The questions asked by Western analysts concerning the impact of the nuclear winter hypothesis on deterrence may be different than those asked by Soviets--because deterrence means something different to Soviets--as does stability and superiority.

V. SUMMARY AND CONCLUSIONS

A common theme of policy analysts, scientists and political leaders is that a credible nuclear policy must take into consideration the consequences of deterrence failing. A full recognition of such consequences should include a knowledge of both short-term and long-term nuclear weapons' effects as well as an appreciation for the vast uncertainties surrounding the war scenarios of man and the interrelationships of the earth's physical and biological processes. Scientific research provides decision makers with such knowledge to serve as a basis for assessing the consequences of nuclear war.

Nuclear weapons were used in 1945 without a reasonable knowledge of even the short-term effects. However, even without this knowledge, nuclear weapons were rapidly incorporated into every facet of the United States' policies for national security. Nuclear weapons now play a central role in the strategy of maintaining the national security of the nuclear powers and in maintaining the overall stability of the international world as influenced by the interests of the nuclear powers. The nuclear strategies of the Soviet Union and of the United States have been shaped by different forces and objectives. The end result, their reliance on nuclear weapons, is a common factor.

This thesis has explored the variety of reactions made in response to the new scientific information concerning the long-term consequences of a nuclear war. Herman Kahn in Thinking About the Unthinkable in the 1980s (written prior to the first nuclear winter studies), classifies the belief that "Nuclear war would result in the destruction of the created order" as one of 12 "almost nonissues." A nonissue is defined as a widely held, emotionally defended proposition that offers little guidance on how to make the world safer from the threat of nuclear war. [Ref. 47:p. 30]

The nuclear winter hypothesis has attracted increased attention in the scientific community over the past five years. The research has advanced to the state that, in spite of remaining uncertainties, there is a consensus of plausibility for the hypothesis and for the impact such an effect would have on the earth's environment. The validity of this "nonissue" has increased to the point that the emotional aspects of the horrors of a nuclear war are now given additional credence by scientific research. The dilemma of the issue is that the "guidance" offered by scientific information has many interpretations on how best to keep the world safe from nuclear war.

A. U.S. FUTURE RESPONSE

In concurrence with the scientific consensus, Western political leaders and policy analysts also exhibit a consensus of acceptance as to the validity of the nuclear

winter hypothesis. In spite of a common acceptance, responses to the nuclear winter hypothesis exhibit wide divergence. An analyst's interpretation of the concept of deterrence and view of the nature of the adversary are key factors in determining a response. There are two broad categories of response in the United States: 1) Those who believe no change in U.S. nuclear policy (weapons technology, arsenal strength, targeting, etc.) is warranted; and, 2) Those who believe the scientific information requires a change in nuclear policy.

The latter group can generally be characterized as proponents of the MAD philosophy. Arms reductions are vital to this approach since fewer weapons are equated to a decreased likelihood of war occurring. There are no winners in a nuclear war and there is no defense from its devastation. Nuclear winter underlines these concerns.

The actions of Congress--mandating a response from DOD on nuclear winter and policy, dissatisfaction with DOD's response, continued measures which emphasize joint research and arms control--suggest that Congress belongs to the second group. Their actions indicate a belief that important policy changes should be derived from the nuclear winter hypothesis. The conflict between DOD's position and the position that Congress is apparently advocating leads to the following inferences:

- DOD states that the present policy provides the best deterrent. If deterrence fails, the present warfighting

strategy of limited nuclear options and escalation control, combined with improved technology, provides the best hope for lessening the chances of a nuclear winter occurring. Since Congress does not agree with this position, it is inferred that Congress is seeking an abandonment of the warfighting emphasis.

- The desire for an abandonment of the warfighting emphasis implies a re-emphasis of the MAD strategy and philosophy.

- A re-emphasis of the MAD philosophy incorporates an emphasis on arms control and the need for drastic arms reductions.

Those who believe that the nuclear winter hypothesis does not warrant a change in policy characteristically emphasize the necessity of maintaining a credible deterrence as perceived by the Soviet Union. There is an appreciation within this group's thinking for Soviet military strategy--a strategy which emphasizes the value of superiority in quantitative and qualitative military forces, designed to fight and win a war. Not only does military superiority provide the best deterrent in the Soviet view, it also influences daily international politics in favor of the Soviet Union, especially when combined with "peace" movement propaganda diversions. Mutual vulnerability is not a part of Soviet doctrine.

The Administration advocates the 'no change' approach as evidenced in the 1985 and 1986 DOD reports required by Congress. U.S. declaratory policy shifted away from the MAD philosophy with NSDM-242 of 1974. The Reagan Administration's Force Modernization Program is a continuation of this approach. The current Program stresses the revitalization

of strategic offensive and defensive forces in an effort to more realistically match capabilities with the declaratory policy and with the operational policy which has been consistent since the 1960s in its counterforce objectives. In the Administration's view, our present strategy is the best way to deter the Soviets and avoid nuclear war--with or without nuclear winter.

The tension between Congress and the Administration surrounding the nuclear winter issue typifies the conflict between the two major schools of thought--assured destruction vs. warfighting--which has characterized the nuclear policy of the United States for the past 40 years. The result of the conflict, while not actually changing operational policy, has influenced the allocation of defense resources. Inconsistent allocation of resources has contributed to a mismatch between capability and declaratory policy.

It is concluded by this author that the DOD reports, in general, offer the most appropriate response to the nuclear winter issue. United States' policy making must be done with an appreciation for Soviet objectives and intentions. The climatic consequences of nuclear war are not likely to be within unilateral U.S. control. Decisions must be made based on their value in an interactive world.

Public claims made by Soviet leaders and scientists state that severe nuclear winter conditions would result

from a small limited use of nuclear weapons, use of weapons in space, and even conventional weapons. The U.S. Department of Defense, while acknowledging the severe consequences of possible nuclear winter effects, has combined its force modernization with a strategy and technology that offer mitigating options to nuclear winter effects should deterrence fail.

It is recognized that nuclear winter concerns may be irrelevant to the inadvertent model of war initiation dominated by non-rational factors. However the response to nuclear winter during time of peace can affect the day to day outcome of relations and likelihood of crisis situations occurring.

The tension between Congress and DOD, the potential impact of an aroused MAD oriented public, and the potential for foreign influence on U.S. policy, all offer avenues which can affect the United States' military posture and national security--in spite of an unchanged operational policy. Enhanced fears of nuclear war promote the influence of self-deterrence. The Soviet use of nuclear winter for its propaganda value stimulates and enhances these potential forces which can create an advantageous environment for the pursuit of Soviet objectives.

B. SOVIET FUTURE RESPONSE

The observed Soviet response to the nuclear winter issue is consistent with their public stance on the horrors of

nuclear war as espoused since the early 1970s. The public view is, however, inconsistent with the steady buildup of offensive and defensive forces. Pursuit of the benefits achieved by propagandizing the nuclear winter issue does not preclude an acceptance of the scientific aspects of the hypothesis at a level comparable to that in the West.

It is the conclusion of this author that asymmetric acceptance of the nuclear winter hypothesis is not the critical issue. The critical issue is how the acceptance affects nuclear strategy, which will be shaped by the 'asymmetric' doctrines of the United States and the Soviet Union.

While the United States has adopted the goals of nuclear stability and parity, the Soviet Union has aimed for military superiority. The capability to wage a nuclear war in terms of military preparation is a major element of a visible Soviet deterrent. Superiority in quality, quantity and preparation provides the best deterrent. Unlike the U.S., the Soviet Union has exhibited consistency in its stable, long-term view of its own security problems and resultant sustained drive to acquire balanced offensive and defensive forces.

It is the author's view that acceptance of the nuclear winter hypothesis would not alter the established soviet doctrine. The hypothesis may, in fact, add support to the strategies of this doctrine.

Recognition of the potential for climatic changes, when combined with the greater vulnerability of the Soviet Union to decreases in temperature and less crop tolerance due to the geography, would make nuclear winter effects of concern for the survivability of the Soviet Union. Expected responses, put in the framework of existing Soviet doctrine, would be to continue to strengthen the Soviet position of military superiority in order to ensure that deterrence continues. In the event that deterrence fails (due to aggression by the West), the defensive measures in effect, and improvements being pursued, would serve to ameliorate nuclear winter conditions. Their long-standing civil defense and grain storage efforts for surviving a nuclear war are much more likely to meet the challenges of a nuclear winter environment than the insubstantial plans of the U.S.

Additionally, a warfighting strategy requires survivable C3I capabilities and reliable weapon systems. Regardless of its long-term climatic effects, the nuclear winter issue has identified the problem of enormous amounts of particulate matter elevated into the atmosphere during a war. In order to maintain superior warfighting capabilities, Soviet technology would have to address the functioning of systems in a perturbed environment.

The DOD reports failed to address similar concerns in the United States, perhaps in an effort to avoid further confrontation between the warfighting and MAD proponents.

It would be expected that information gained from scientific research would be applied to a survivable weapons technology, especially in light of the emphasis placed on a survivable C3I as part of the Administration's declaratory policy.

C. THE FUTURE OF NUCLEAR WINTER RESEARCH

The complexity of the nuclear winter hypothesis and its biological implications offers an area of scientific research which can never be definitively explained and quantified. As such, the hypothesis offers inexhaustible opportunities for research.

The Soviet Union is in a position to benefit from continued joint research in several respects: 1) for the scientific pursuit of increased knowledge in order to meet the challenge of preparation for survival in an altered environment and for the C3I and weapons modification needed to function in a perturbed environment during a war; 2) for the benefit of favorable gains in world opinion as a concerned nation contributing to peaceful endeavors; 3) for the benefit of technology transfer; and, 4) as a method to gain access to and influence the decision making process in the United States.

Both groups in the United States--those advocating change, as well as those advocating no change--agree on the need for additional research for the scientific pursuit of increased knowledge. An additional motive for more research

of MAD proponents would be continued public and scientific attention on the consequences of nuclear war which they interpret as supporting their position.

A motive of those advocating no change in nuclear policy would be to provide evidence that they are truly concerned about such consequences--even though the research will not result in policy changes--possibly lessening criticism from their opponents. Due to the possibility of endless research, the statement that the present state of uncertainty surrounding the nuclear winter hypothesis does not warrant policy changes at this time, becomes equivalent to the statement that nuclear policies will remain unchanged regardless of the outcome of the technical studies.

D. POLICIES REMAIN UNCHANGED

Many policy analysts believe that the degree of acceptance of the validity of the nuclear winter hypothesis by the United States and the Soviet Union will be reflected in the degree to which their strategic postures and policies are modified by the hypothesis. The evidence of observed responses to date, in combination with an appreciation for factors influencing the past development of both nations' nuclear policies, do not support this belief. It is the conclusion of this author that the degree of acceptance will not directly be reflected in any policy changes.

However, due to the nature of democracies, the United States decision makers may feel increased external as well

as domestic pressures to pursue actions which may actually decrease the security of the United States--such as inequitable arms control agreements. This situation is enhanced by the nuclear winter hypothesis and will be pursued by the Soviets to suit their objectives. Having presented the conclusion that policy will not change as a result of the nuclear winter hypothesis, the U.S. must still be concerned with its ability to implement its policy. The U.S. must confront public opinion and confront the pervasive nature of Soviet propaganda.

Nuclear winter effects, unsuspected for 40 years, highlight how little is known of the consequences of nuclear war. The information that is available, combined with the uncertainties, has not altered the nuclear decision making process. The nuclear policies which developed without scientific knowledge of the consequences of nuclear weapons use--except in direct military applications--appear resilient to any factors which begin to disclose the consequences.

LIST OF REFERENCES

1. Katz, A.M., Life After Nuclear War, Ballinger Publishing Company, 1982.

2. Scientific Committee on Problems of the Environment (International Council of Scientific Unions), Environmental Consequences of Nuclear War, Volume I: Physical and Atmospheric Effects, by A.B. Pittock et al., John Wiley and Sons, 1985.

3. Weinberger, C.W., Annual Report to the Congress Fiscal Year 1988, Department of Defense, 1987.

4. Friedberg, A.L., "A History of the U.S. Strategic 'Doctrine'--1945 to 1980," Journal of Strategic Studies, v. 3, n. 3, pp. 37-71, December 1980.

5. Pipes, R., "Why the Soviet Union Thinks It Could Fight and Win a Nuclear War," Commentary, v. 64, n. 1, pp. 21-34, July 1977.

6. Kennedy, R., "Nuclear Winter, War Prevention and the Nuclear Deterrent," in Nuclear Winter, Deterrence and the Prevention of Nuclear War, pp. 148-165, edited by P.C. Sederberg, Praeger Publishers, 1986.

7. Sloss, L. and Millot, M.D., "U.S. Nuclear Strategy in Evolution," Strategic Review, v. 12, n. 1, pp. 19-28, Winter 1984.

8. Payne, K.B., Nuclear Deterrence in U.S.-Soviet Relations, Westview Press, 1982.

9. Erickson, J., "The Soviet View of Deterrence: A General Survey," Survival, v. 24, n. 6, pp. 242-251, November/December 1982.

10. Tritten, J.J., Soviet Naval Forces and Nuclear Warfare--Weapons, Employment, and Policy, Westview Press, 1986.

11. Goure, L., et al., The Role of Nuclear Forces, p. 9, cited by R. Pipes, "Why the Soviet Union Thinks It Could Fight and Win a Nuclear War," Commentary, v. 64, n. 1, pp. 21-34, July 1977.

12. Pipes, R., "Soviet Strategic Doctrine: Another View," Strategic Review, v. 10, n. 4, pp. 52-58, Fall 1982.

13. Ermath, F.W., "Contrasts in American and Soviet Strategic Thought," in Nuclear Strategy, Arms Control, and the Future, pp. 159-165, edited by P.E. Haley, D.M. Keithly, and J. Merritt, Westview Press, 1985.

14. Mitchell, R.J., Ideology of a Superpower, Hoover Institution Press, 1982.

15. Lee, W.T. and Staar, R.F., Soviet Military Policy Since World War II, Hoover Institution Press, 1986.

16. National Academy of Sciences, The Effects on the Atmosphere of a Major Nuclear Exchange, 1985.

17. Crutzen, P.J. and Birks, J.W., "The Atmosphere After a Nuclear War: Twilight at Noon," Ambio, v. 11, n. 2-3, pp. 114-125, 1982.

18. Sagan, C., "The Atmospheric and Climatic Consequences of Nuclear War," in The Cold and the Dark, pp. 3-39, by P. Ehrlich, C. Sagan, D. Kennedy and W. Roberts, W.W. Horton and Co., 1983.

19. Hahm, W.K., Nuclear Winter: A Review of the Models, The Rand Corporation, Report No. P-7121-RGI, July 1985.

20. Turco, R.P., et al., "Nuclear Winter: Global Consequences of Multiple Nuclear Explosions," Science, v. 222, n. 4630, pp. 1283-1292, 23 December 1983.

21. Sagan, C., "Nuclear War and Climatic Catastrophe," in The Long Darkness, pp. 3-61, edited by L. Grinspoon, Yale University Press, 1986.

22. Malone, T., "International Scientists and Nuclear Winter," Bulletin of Atomic Scientists, v. 41, n. 11, pp. 52-55, December 1985.

23. Schneider, S.H. and Thompson, S.L., "Nuclear Winter Reappraised," Foreign Affairs, v. 64, n. 5, pp. 981-1005, Summer 1986.

24. Berger, E., "Nuclear Winter, Or Nuclear Fall?," Eos, v. 67, n. 32, pp. 617-621, 12 August 1986.

25. Ghan, S.J., MacCracken, M.C., and Walton, J.J., The Climatic Response to Large Atmospheric Smoke Injections: Sensitivity Studies with a Tropospheric General Circulation Model, Lawrence Livermore National Laboratory, January 1987.

26. Mettlach, T.R., Changes in the Ocean Mixed Layer Following Extraordinary Atmospheric Forcing, M.S. Thesis, Naval Postgraduate School, Monterey, California, December 1985.

27. Mettlach, T.R., et al., "The Response of the Ocean to a Large Summertime Injection of Smoke in the Atmosphere," Journal of Geophysical Research, v. 92, n. C2, pp. 1967-1974, 15 February 1987.

28. United States General Accounting Office, Report to the Congress; Nuclear Winter: Uncertainties Surround the Long-Term Effects of Nuclear War, Washington, D.C., March 1986.

29. Grover, H.D. and Harwell, M.A., "Biological Effects of Nuclear War II: Impact on the Biosphere," BioScience, v. 35, n. 9, pp. 576-583, October 1985.

30. Tangley, L., "The Year After," BioScience, v. 35, n. 9, pp. 536-540, October 1985.

31. Scientific Committee on Problems of the Environment (International Council of Scientific Unions), Environmental Consequences of Nuclear War, Volume II: Ecological and Agricultural Effects, by M.A. Harwell and T.C. Hutchinson, John Wiley and Sons, 1985.

32. Scherr, J.S., "Coming to Grips with Nuclear Winter," Environment, v. 27, n. 8, pp. 4,5,40, October 1985.

33. Powers, T., "Nuclear Winter and Nuclear Strategy," The Atlantic Monthly, v. 254, n. 5, pp. 53-64, November 1984.

34. Drew, D.M. et al., Nuclear Winter and National Security: Implications for Future Policy, Air University Press, July 1986.

35. Schnelling, T.C., The Strategy of Conflict, Oxford University Press, 1960, cited by Baugh, W.H., "Dilemmas of Deterrence Policy," in Nuclear Winter, Deterrence and the Prevention of Nuclear War, pp. 37-53, edited by P.C. Sederberg, Praeger Publishers, 1986.

36. Gertler, J.J., Some Policy Implications of Nuclear Winter, The Rand Corporation, Report No. P-7045, January 1985.

37. Voters Options on Nuclear Arms Policy, The Public Agenda Foundation, 1984, cited by Nye, J.S., Jr., "Nuclear Winter and Policy Choices," Survival, v. 28, n. 2, pp. 119-127, March/April 1986.

38. Nye, J.S., Jr., "Nuclear Winter and Policy Choices," Survival, v. 28, n. 2, pp. 119-127, March/April 1986.

39. Feldbaum, C.B. et al., Implications of the Nuclear Winter Thesis, Palomar Corporation, June 1985.

40. Pittock, A.B., "Rapid Developments on Nuclear Winter," Search, v. 17, n. 1-2, pp. 23,24, 1986.

41. Marshall, E., "Nuclear Winter Debate Heats Up," Science, v. 235, n. 2, pp. 271-273, 16 January 1987.

42. Brooks, L.F., "Memorandum for Adm. Watkins on Nuclear Winter Conference," Ser. 503, dated 29 March 1985.

43. Cabayan, H.S., ed. et al., "Weapons Design and Development," Energy and Technology Review, Lawrence Livermore Laboratory, September 1986.

44. Cabayan, H.S., ed. et al., "State of the Laboratory," Energy and Technology Review, Lawrence Livermore Laboratory, June-July 1986.

45. Pincher, C., The Secret Offensive, Sidgwick and Jackson Limited, 1985.

46. Yost, D.S., "The Soviet Campaign Against INF in West Germany," in Soviet Strategic Deception, pp. 343-374, edited by B.D. Dailey and P.J. Parker, Hoover Institute Press, 1987.

47. Kahn, H., Thinking About the Unthinkable in the 1980s, Simon and Schuster, 1984.

48. Ground Zero, Nuclear War: What's in it For You?, Pocket Books, 1982.

49. Ball, D., and Richelson, J., eds., Strategic Nuclear Targeting, Cornell University Press, 1986.

50. Haley, P.E., Keithly, D.M. and Merritt, J., Nuclear Strategy, Arms Control, and the Future, Westview Press, 1985.

51. Arkin, W.M. and Fieldhouse, R.W., Nuclear Battlefields: Global Links in the Arms Race, Ballinger Publishing Company, 1985.

52. Sederberg, P.C., Nuclear Winter, Deterrence and the Prevention of Nuclear War, Praeger Publishers, 1986.

53. Gray, C.S., "Nuclear Winter and the Future of Deterrence," The Washington Quarterly, v. 8, n. 3, pp. 85-96, Summer 1985.

54. Weinberger, C.W., The Potential Effects of Nuclear War on the Climate--A Report to the United States Congress, Department of Defense, Office of the Secretary of Defense, March 1985.

55. Nuclear Winter and its Implications, Hearings before the Committee on Armed Services United States Congress, U.S. Government Printing Office, 2 and 3 October 1985.

56. Weinberger, C.W., Technical Issues Update, Department of Defense, Office of the Secretary of Defense, May 1986.

57. Huckaby, J., House Congressional Resolution 73, submitted at the 1st Session of the 100th Congress, 11 March 1987.

58. Taft, W.H., cover letter to Technical Issues Update by C.W. Weinberger, 9 May 1986.

59. Shenfield, S., "Nuclear Winter and the USSR," Millenium: Journal of International Studies, v. 15, n. 2, pp. 197-208, Summer 1986.

60. Goure, L., "Nuclear Winter in Soviet Mirrors," Strategic Review, v. 13, n. 3, pp. 22-38, Summer 1985.

61. Lynch, A., Political and Military Implications of the "Nuclear Winter" Theory, Institute for East-West Security Studies, Inc., 1987.

62. Federal Broadcast Information Service, "Kondratyev Views Dangers of 'Nuclear Summer'," Moscow TASS in English, 1830 GMT, 13 January 1986, in FBIS Daily Report: Soviet Union--National Affairs, p. u1, 14 January 1986.

63. Federal Broadcast Information Service, "'Nuclear Winter' Possible from Conventional War," Moscow TASS in English, 1330 GMT, 28 February 1986, FBIS Daily Report: Soviet Union, p. AA3, 5 March 1986.

64. Committee of Soviet Scientists for Peace, Against Nuclear Threat, Global Consequences of Nuclear War and the Developing Countries, 1984, cited by S. Shenfield, "Nuclear Winter and the USSR," Millenium: Journal of International Studies, v. 15, n. 2, pp. 197-208, Summer 1986.

65. Heuer, R.J., "Soviet Organization and Doctrine for Strategic Deception," in Soviet Strategic Deception, pp. 21-53, edited by B.D. Dailey and P.J. Parker, Hoover Institution Press, 1987.

66. Dailey, B.D., Deception and Self-Deception in Arms Control: The ABM and Outer Space Treaties Reconsidered, Doctoral Dissertation, University of Southern California, August 1987.

67. Shultz, R.H., and Godson, R., Dezinformatsia, Berkeley Publishing Group, 1986.

68. Shevchenko, A.N., "Danger: The Networks are Misreading the Russians," TV Guide, 9 August 1986, p. 8, cited by B.D. Dailey, Deception and Self-Deception in Arms Control: The ABM and Outer Space Treaties Reconsidered, Doctoral Dissertation, University of Southern California, August 1987.

INITIAL DISTRIBUTION LIST

		No. Copies
1.	Defense Technical Information Center Cameron Station Alexandria, Virginia 22304-6145	2
2.	Library, Code 0142 Naval Postgraduate School Monterey, California 93943-5002	2
3.	Department Chairman, Code 56 Department of National Security Affairs Naval Postgraduate School Monterey, California 93943-5004	1
4.	Center for Naval Analysis 4401 Ford Ave. Alexandria, Virginia 22302	1
5.	Prof. K. Kartchner, Code 56Kn Department of National Security Affairs Naval Postgraduate School Monterey, California 93943-5004	4
6.	Prof. R. Haney, Code 63Hy Department of Meteorology Naval Postgraduate School Monterey, California 93943-5004	2
7.	Lt. G. Griffin PSD Box 36 FPO New York, 09571-1436	2
8.	Lt. Bob Gourley P.O. Box 313 FOSIF WESTPAC FPO Seattle, 98768-1808	1
9.	Lt. T. Mettlach USS Sterett (CG-31) FPO San Francisco, 96678-1154	1

10. Stephen Borrmann 1
Institut für Meteorologie
Johannes Gutenberg-Universitat
D-6500 Mainz
Postfach 3980
F.R.G.

Thesis
G7685 Griffin
c.1 Nuclear winter and nuclear policy: implications for U.S. and Soviet deterrence strategies.